ANNUAL RATES OF SUBSCRIPTION.

Farmers, Graziers, Horticulturists, and Schools of Arts, **One Shilling.** Members of Agricultural Societies, **Five Shillings,** including postage. General Public, **Ten Shillings,** including postage.

VOL XLI. 1 MAY, 1934. PART 5.

Event and Comment.

Anzac.

ANZAC DAY remains one of our most inspiring anniversaries, and even after the lapse of less than a score of years the Epic of Gallipoli has already become a great and glowing tradition of our race. In our observance of Anzac Day, which this year as in previous years was Australia-wide, one senses the vital element that keeps Australia true, not only to herself but also true to the traditions of the British peoples from whom we are proud to claim descent. Anzac Day will continue to hold its place in history. We have come to regard it not only as a day of reverent memory of the poignant tragedies of war, but a day on which our sense of spiritual values is strengthened by a contemplation of the invincible valour, the service, and the sacrifice of the men who set out on a great adventure and did not come home. Theirs was a venture of courage, and their courage never failed; theirs was a venture of faith, and their faith remains undimmed—an inspiration, surely, for us to face the perplexing problems of the present with something of the same strong faith and courage.

The spirit of Anzac is, after all, only an expression of the spirit of the pioneers of this country. That spirit is equally our inheritance to-day. So while honouring the men who gave their all for Australia in the war with deep reverence and respect, let us not forget that Australia calls to-day just as insistently for service as she did in 1914—a service we cannot deny her, a service that certainly was not denied her by her youth of yester-year who died in her defence.

Problems of Rural Development.

DEPARTMENTAL reports are usually regarded as dry and uninspiring documents, yet, rightly read, there is a wealth of interesting matter, even romance, in these reports that have so much to record of the building-up of a rural civilisation in Queensland. Reports, say, of the Department of Agriculture and Stock, of the Department of Public Instruction, and of the Main Roads Commission—to mention only a few—are all worth reading. The Annual Report of the Department of Agriculture and Stock deals with real problems of rural development. It shows that both primary and secondary industries are interwoven and inter-related to such an extent that it is scarcely possible to disengage them. And this fact shows the necessity of our determining and maintaining a balance between them if the country generally is to prosper. There is, however, a difference between the agricultural and manufacturing industries as they are now developed, particularly in regard to proper price relationship in respect of one commodity and another. Manufacturers can restore or adjust matters affecting prices and other economic factors by modernising their methods, reducing costs, discharging labour, introducing new machinery, and changing their product; or even getting out into other fields which can be done, not easily, certainly, but with comparative facility. In agriculture, on the other hand—with its numerous scattered units, its unrelated establishments, its small proportion of outside labour, its relatively large fixed capital, its slow turnover, its combination of business and industry with home and social life, its lack of flexibility in organisation, the perishability of its products, its dependence on the weather, and time as an irreducible factor—adjustment is slow and difficult. Since the manufacturer can reckon on a fairly quick adjustment of production to demand, he can, when prices drop, cut his costs with some confidence that in that way he will find, at least, temporary economic salvation. The farmer cannot do that to any appreciable extent. As an individual he has very little chance of cutting his costs, except by increasing production. He may, of course, cut out waste in production; but agricultural production is fundamentally a biological, not a mechanical, process which requires a fixed period of time; so that costs can be reduced only by increasing production in this period, and not by reducing the time required for the crop. Then, if the farmer increases production per acre of a commodity for which there is already a glutted market, prices will probably fall still further. Any plan for improving the conditions of our country life must, therefore, be considered in the light of these fundamental facts, in the light of the essential differences, notwithstanding their economic relationship, between urban and rural industries. The first is governed by fixed principles of mechanism and organisation, while agriculture is controlled entirely by natural conditions, seasonal circumstances, and so forth. So we come to this point: If we are to improve agriculture we have to get right down to business. With any increase in production must go extension of markets and the improvement in marketing facilities, transport, and so on.

And then we come to the question of farm efficiency. In manufacturing the inefficient producer generally goes to the wall unless his business is bottle-fed, or his commercial life is artificially prolonged by outside assistance—and probably at the expense of some other industry or organisation. In agriculture the inefficient producer may still, like

a poddy calf, remain on the bucket indefinitely, to the general detriment of the industry. All this is merely suggestive of the problems of building up our rural civilisation through agriculture, which are discussed, in one form or another, every year in the Agricultural Report.

Home Project Clubs.

COMING now to the work of the Department of Public Instruction, there is nothing in its last report more impressive than the section on Home Project Clubs, unless it be that descriptive of the success of the Correspondence Courses, whereby modern education is brought to the loneliest youngster in the remotest part of the State. That great service has certainly become one of the most important factors in the building up of a rural civilisation in Queensland. To quote from the report directly—

> The School and Home Project movement is one of the few departmental activities which, during this time of restricted funds and consequent non-expansion, it has yet been possible for the department to continue to develop. The growth of this movement is at once a tribute to and the result of teachers' and parents' appreciation of the educational and economic values claimed for the Project scheme at the time of its introduction and since. In country districts and even in urban schools it is becoming more and more realised that no school activity provides a richer field for responsible exercise in honest thinking and judgment-formation than does agriculture worked and studied on the Project plan.
>
> For the most part, teachers and clubs select projects which are agricultural in nature; yet, agricultural though the project is, the fact that the agricultural product is relatively unimportant, while the child—the member—is all-important, is becoming more and more appreciated by teachers; inherent educational values are becoming more and more recognised. Though the immediate purpose of club work is educational, teachers are still conscious that the children of to-day are the responsible citizens of to-morrow, and that from an educated, observant, reasoning youth economic benefits will in due course come.

The Broad Highway.

THE Report of the Main Roads Commission is a survey of a year's achievements that leaves the impression that the Commission is one of the most important factors in our rural development. One of the most important aspects of the history of civilisation is the development of the road for, in a very real sense, "transportation is civilisation." The literature of the road is curiously scanty. It provides the commonest of metaphors, but is one of the rarest of subjects. Poetry, imaginative prose, religion itself, would lose much if they were deprived of such convenient symbols as the broad, high road, the narrow path, the beaten track, the accustomed way, and the slippery slide to perdition. Civilisation "begins with wandering trails in the dim mists of pre history"; its present stage is the construction of solid concrete or bitumen highways reserved for fast motor traffic; between the two lies the material history of mankind. As a factor in rural development of Queensland, the importance of a sound main road policy is thus obvious to all who care to give the subject a single thought.

Queensland Citrus Scale Insects and their Control.

By W. A. T. SUMMERVILLE, M.Sc., Assistant Entomologist.

THIS report is primarily the result of investigations carried out during the past three years. For several years prior to the commencement of active investigational work, however, extensive observations on citrus scale insects were made whilst research work on other pests of this plant was being prosecuted. The conclusions arrived at and here presented are therefore based on work carried on over a considerable number of years.

Commonly, the problem of scale insect control on citrus in this State is not a simple one, but is complicated by the frequent occurrence of mixed populations of the scales themselves and by the necessity of using artificial methods of control for other pests and diseases. In the present state of knowledge, when the treatment for a scale insect materially affects or is affected by the recommended method of control of several other pests and major diseases, it is the scale insect treatment which must be varied if at all possible. Thus it becomes necessary to take into account the influence of other operations on the scale insect position, and questions of compatability of sprays and following treatments must be considered.

Whilst the control of almost any pest is influenced by many factors not specifically assignable to the insect in its simple relationship to the host, with no other pest or group of pests to which citrus in Queensland is subject are these "outside" factors of such great direct importance. When the habits of a pest are known it is often possible to anticipate a position, and anticipation usually means that the solution of the problem is facilitated. It is advisable, therefore, that growers familiarise themselves with the habits of each of the important species under different conditions. To do this some knowledge of the biology of the insects is necessary, and for this reason the first section of this report is devoted to an account of the rudiments of their biology.

Many growers are content to know that good results may be obtained against a particular pest with a certain insecticide. Fortunately, however, an increasing number are realising the inadequacy of that amount of knowledge, and time of application is being recognised as an important factor in the successful control of many pests. Time of application can seldom be accurately stated in terms of a calendar, though some indication may be given in that way. This is particularly true of citrus insects in Queensland. Here commercial citrus-growing areas are scattered over an area of almost 200,000 square miles, and variations in climate, which are reflected in the development of the pests, are only to be expected. It is necessary, therefore, to refer to times of application of control measures as taking place at a certain stage in the life history of the insect. Growers accordingly will always need to carry out observations on certain details for themselves, and here again a knowledge of the habits and biology of the pest will be of

considerable benefit. It will be quickly found that by making observations and interpreting what is seen in terms of the information given below much better results will be obtained than by the most slavish adherence to any generalised recommendations.

THE BIOLOGY OF THE SCALE INSECTS.

The forms and appearances assumed by the different species vary enormously, and it would be very difficult to compile a short and simple description which would enable orchardists to recognise an insect from its external appearance as being a member of the group known as scale insects or Coccidæ. In fact, in making almost any generalised statement concerning these insects, variations and exceptions at once come to mind, and if only those exceptions which apply to the particular species known to feed on citrus in this State were to be included, a description would be necessarily long and rather involved. This account is accordingly intended merely to give orchardists the facts of outstanding importance and interest which will enable them to obtain a working understanding of the group.

Whilst no short account can be given, it may be said that the whole range of forms is so different from those of other insects that scale insects can usually be readily recognised as such, once one has become familiar with a few species.

The Scale Covering.

In the majority of cases there is little to suggest the insect nature of the pest. In many cases the insect itself is not seen from the outside, as the body is entirely hidden from view beneath a secretion exuded by the insect. This secretion often forms a scale-like covering, and it is from this structure that the vernacular name is derived. The scale secretion may be one of many forms; for example, in the female red scale, *Aonidiella aurantii* (Maskell), it is circular, almost flat, somewhat parchment-like in consistency, and almost transparent (Plate 122), whilst in the white wax scale, *Ceroplastes destructor* Newstead, the covering is a thick waxy substance, rather irregular, though fairly constant, in shape, and almost as high as long. The shape of the covering at times gives little clue to the shape of the insect beneath it, but in general the sizes are comparable. In addition to this scale covering the upper surface a second scale may be found on the under or ventral surface. This ventral scale is commonly thin and transparent and very easily ruptured.

Some species do not secrete a "scale" at all, but in so far as the female is concerned remain naked throughout life. These naked species are commonly referred to as "soft" or "unarmoured" scales (Plate 126) in contradistinction to the armoured species described above. In these soft scales the exposed surface or dorsal derm is usually much thickened and hardened. Even with these naked species the resemblance to other insects is often remote, but they may perhaps be likened somewhat to a small tick.

For the most part the scale insects remain practically stationary on the plant once they have settled down and commenced to feed, but some, particularly those belonging to the mealy bug group, move freely about their host plant.

Reproduction.

The adult females, according to the species, either produce eggs or give birth to living young. When eggs are produced these may be deposited loosely beneath the body of the mother, and in these cases the body may shrivel or shrink up against the upper or dorsal surface so that the eggs ultimately occupy almost the whole of the cavity formed by the upper surface and the plant surface or the ventral scale. Certain species deposit their eggs in specially produced structures, which are more or less bag-like and are termed ovisacs. These ovisacs (Plate 127, fig. 1) vary greatly in detailed structure, but in so far as the citrus scales which produce them are concerned may be described briefly as cottony or floury bags. It is characteristic of these insects that there is one continuous period of reproduction. This period may be protracted, but in all cases observed, once the continuity has been broken there is no resumption, and the old female invariably dies very soon after completion of this work.

The Young Scales.

When first emerged from the egg or mother the young of many species of scale insects are difficult to differentiate, and there is commonly no discernible differences between the two sexes. In general the young are minute soft-bodied creatures, very pale green, creamy yellow, or almost transparent in appearance, and are equipped with six comparatively well developed and conspicuous legs. The antennæ or feelers are also usually large compared with the size of the insect itself. In this stage the insects are well described by the vernacular name of "crawlers" (Plate 127, fig. 4). On emerging from beneath the covering provided by the mother, the young scatter to a greater or lesser degree according to species and circumstances. Some settle down almost at once, but others wander about for several days. When this wandering period is completed the insect has found a site at which to feed, and it settles down and becomes fixed to the plant, and, as has been said, for the most part the remainder of its life is spent in that place. This does not apply to the male, for with this sex, though the immature stages remain fixed, the adult is a free moving creature.

Moulting and Development.

With the armoured species, the secretion of the scale covering begins immediately feeding has commenced. The first covering protecting the young, however, may differ greatly in appearance and texture from the scale which appears later. From this time onwards the differences between species becomes more and more apparent. The insect grows by a series of moults, there apparently being two moults in the case of the females of every species. The moulted skins or exuviæ may be included in the covering, and in such cases can commonly be found at the anterior end, or towards the central point of circular species, of the scale as a conspicuously different area from the remainder of the covering. When incorporated in the covering in this way these cast skins are referred to as pellicles. After the second moult the sexes can be distinguished, and in many cases the males bear little or no resemblance to the females of the same species, even on external characters. Commonly, the male is considerably smaller than the female, and the scale covering may be quite different. In the case of the white louse scale, for example, the female has a drab, brown, somewhat mussel-shaped scale of rather leathery or thick parchment-like texture, while

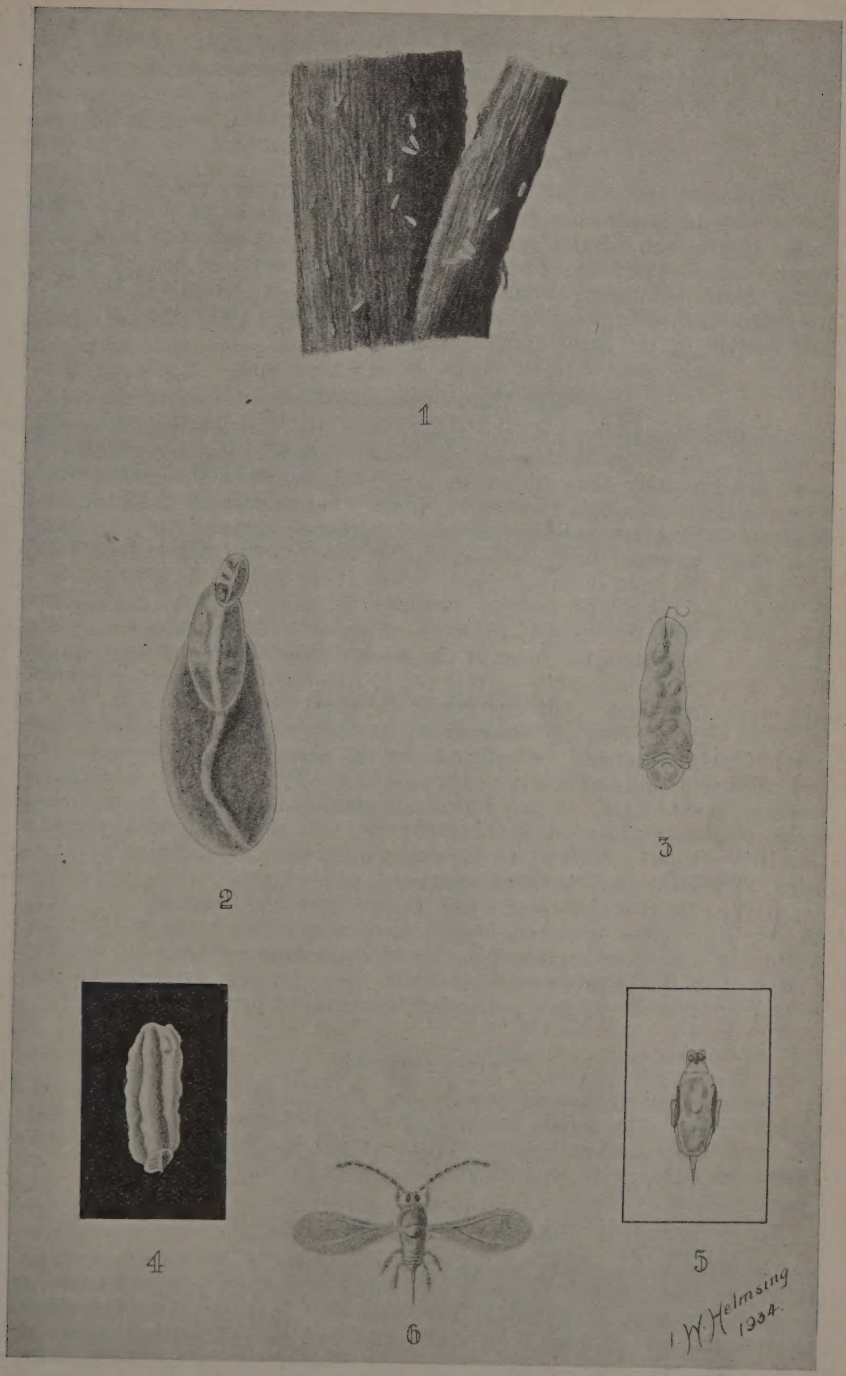

PLATE 121.

White Louse, *Chionaspis citri* Comstock. Fig. 1, Male tests on bark × 3. Fig. 2, Female test × 24. Fig. 3, Adult female × 24. Fig. 4, Male test × 24. Fig. 5, Male pupa × 24. Fig. 6, Adult male × 24.

the male scale is pure white, more or less cylindrical, deeply keeled and of somewhat cottony consistency. The differences in the insects themselves in all cases is even greater.

The Female Scale Insect.

The female (Plate 121, fig. 3) does not change very greatly in form during development, though usually it is more rounded in the later stages than when in the crawler form. The detailed structure may become much modified. The legs and antennæ may be lost or represented finally by minute stumps. In other species both legs and antennæ are retained throughout life, but even in such cases there is often some modification of the form of these organs.

The Male Scale Insect.

In the development of the male insect the changes are far more profound. In so far as those species which attack citrus are concerned, there are typically four moults in the development of the male insect. After the second moult the insect enters what is termed the prepupal stage. In this stage the characters are rather ill-defined unless viewed under high magnification, and can only be briefly described as indicative of those of the next or pupal stage. Even if the species be a naked one, at this time the males become enclosed in some form of investment comparable with the cocoon of a moth. Similarly the pupal stage (Plate 121, fig. 5) indicates the form of the adult in the same way as does the pupa or chrysalis of a moth. After the fourth moult the insect is perfect and ready to emerge. On emergence the adult male (Plate 121, fig. 6) is found to be greatly different from its female. The male has a fine narrow body, long and very fine antennæ, generally conspicuous eyes, and the whole appearance suggests fragility. Typically, the adult male possesses a single pair of fine delicate wings which carry a single forked vein. Probably the most striking character of the male scale insect is that it is without mouth parts, these having disappeared during development. The adult male is therefore unable to feed, and is thus very short-lived. The great majority of males die within a few hours of emergence, and probably none live much longer than twenty-four hours at the most. Adult males are rarely found in the orchard, and certainly no one but a student of the group would recognise these delicate winged creatures as the consorts of the fixed, sluggish, fat-looking female scale insects.

Parthenogenesis.

Many species of scale insects are able to reproduce without the presence of a male, and in the case of some well-known species the male has never been discovered. With certain species the female may reproduce either with or without the assistance of the male.

Rate of Multiplication.

That scale insects are so important as pests is due to a very large extent to the rapidity of their development, together with the large number of young produced by each female. In some cases individual females give rise to more than 2,000 eggs, and though natural mortality is certainly very high, in most cases the number surviving is commonly so great that huge populations are quickly built up from but a small number of original insects.

Manner of Feeding.

Scale insects possess rather complicated mouth parts, which, however, may be briefly described as long, slender, piercing, and tubular. The most conspicuous feature of these organs is their length, which at times is much greater than that of the entire body of the insect. The plant is pierced and the tube inserted into the internal tissues and the food sucked up in fluid form. The manner of feeding is essentially the same as that of the plant bugs. The actual injury done can best be considered in conjunction with each species in so far as citrus is concerned. The general direct effects of such a sap-sucking insect need no description. The indirect effects, however, are often just as important, and these, though readily to be expected, are often overlooked. The weakening of parts resulting in the entrance of other insects and fungal parasites is commonly a most important consideration. Unfortunately, it happens all too frequently that growers do not become concerned about a pest until or unless it is obviously a menace to the crop, but it must be remembered that anything which interferes with the vigour of any part of the tree affects the crop.

FACTORS INFLUENCING THE INCIDENCE OF CITRUS SCALE INSECTS.

Influencing the incidence of citrus scale insects are dispersion, climatic, locality, soil, and plant factors, and the various natural enemies. These will be discussed in turn.

Dispersion Factors.

As will be readily understood from what has been written concerning their biology, the scale insects are largely dependent on external factors for dispersal. The only form which possesses wings is the adult male, which is of little or no consequence in the matter, and, furthermore, the wings are so delicate that migration for any appreciable distance could only take place under most favourable circumstances. The females are, of course, the important factor. In the first stage for a time these are free-moving, but they soon become fixed to the plant and are removed only with difficulty and great probability of injury to vital organs, particularly the mouth parts. Species such as the mealy bugs, which habitually move about the plant for the greatest part of their life, may, however, be transferred from tree to tree at almost any time except, perhaps, during the reproductive period, but with the great majority of scale insects it is only in the first few days after emergence that dispersal is at all likely to take place. At this time the larvæ are able to crawl well, but they are so minute that the distance between two trees in an orchard or between a native host plant and an orchard tree is, comparatively speaking, very great, and the likelihood of such small, soft, and defenceless creatures safely reaching a destination five yards away is very remote. Furthermore, tests were carried out with a number of common species, and in each case it was found that when placed on soil under a tree the crawlers meandered about apparently without sense of direction. In almost every case, after hours of crawling, each individual ultimately arrived at a point within a few inches of the one at which it commenced. It is thus evident that, unaided, there will be little change of scale insects from tree to tree. Crawling is of some importance in the distribution of the pests on the tree on which the mother reproduced, and this method of dispersal is of moment in

another matter. In the case of some species, such as red scale, for instance, the females may continue to reproduce freely on fruit stored before marketing. The young of these females may be disseminated through many boxes of fruit in this manner. This point is of importance to lemon-growers, and also in connection with the importation of some species from one district or country to another.

The minute first-stage larvæ are easily dislodged from a leaf or twig when they are in the crawling stage, and are consequently carried away by air currents, and it is chiefly by this means that many species are distributed. Naturally, the degree to which the winds effect transportation depends to a certain extent on the length of time the young are crawling about the plant before attaching themselves securely to it. This is very well shown in the cases of pink wax and red scale. The latter is one of the quickest citrus scales in the matter of settling down, whilst pink wax commonly moves about freely for several days. Wind distribution of pink wax is much more efficient than with the red species, which is, in fact, but slowly scattered by this means. It will be seen then that the direction of prevailing winds becomes a consideration in dealing with some species of scale pests, and it will be understood that in carrying out control operations against species distributed to an appreciable extent in this way from outside sources it may be wise to commence operations on the leeward face of the orchard.

The minute crawlers are at times carried from one tree to another on hands, clothes, secateurs, and other such tools which come in contact with various trees in quick succession.

The introduction of scale insects from one district to another usually only concerns the grower in respect to bringing young trees on to his orchard. This has undoubtedly been the means of establishing certain species in some parts in the first place, and it is always wise to procure trees from the cleanest possible nursery apart from the fact that the infested young tree must be adversely affected by the presence of heavy scale infestation.

Climatic Factors.

Climatic conditions exert a very marked influence on both the incidence and development of every species of citrus scale insect. The optimum conditions for each species will be dealt with later in connection with the individual species. In so far as the present discussion is concerned, however, there is one point to be stressed. The majority of citrus scales in Queensland are present in every major commercial citrus district. In normal times certain of these species will be found to be of little or no importance in one particular locality. However, very quick response to climatic conditions is characteristic of practically every species, and thus in an abnormal season the position in any orchard may be fundamentally changed. It is therefore wise for an orchardist to become familiar with the essential points concerning each species encountered, even though certain ones may be considered of no importance to him at present.

Where it is the custom to draw up in advance a spraying programme for the year, as is often advisable, the possible variation of climatic conditions must be kept in mind. Far too often growers use a spray simply because they obtained good results with it at that time the previous year. It is surprising, too, how frequently growers will purchase large quantities of some material months in advance, only to find

subsequently that this material is not needed. Unfortunately, the rule in such cases appears to be to use the material on hand, even though it is going to give no benefit, and at the same time to neglect to obtain the correct spray. This is sometimes the result of lack of knowledge in the first place as to what spray is to be used in certain circumstances, but most commonly it is due to failure to recognise that seasons vary from time to time, and that climatic factors exercise great influence on many pests, particularly scale insects.

Locality Factors.

Factors in scale incidence which arise out of particular local conditions are, of course, in many cases more properly classified under other headings, particularly climatic conditions. However, it is necessary in this connection to point out that very local physical features at times exert considerable influence on atmospheric conditions. Protection afforded one orchard by a hill or a large belt of scrub or forest may decidedly affect the incidence of scale insects. The presence of a large area of an alternative host plant, such as often happens in the case of pink wax, may mean that one orchardist may need to adopt control measures different from those chosen by a fairly close neighbour. The influence of purely local factors is often ignored, particularly by small growers, who frequently too readily follow the lead of a neighbour merely because he has clean trees.

The position of trees is also of moment sometimes where the land slopes steeply. Thus trees high up the slope may differ from those lower down, the difference usually being confined to degree of infestation. Positional influence is sometimes bound up with soil factors or exposure to winds, and in such cases the difference may extend to species infesting the trees. The proximity of a windbreak, especially a natural windbreak in which there occurs an alternative host tree, and more particularly the proximity of another orchard, may be of moment.

Of interest, and at times importance too, is the position of the tree relative to a road or other such source of dust. The dust may collect on trees fringing a road, and by interfering with the functioning of the pores in the leaf and other parts become a factor in connection with scale insect incidence. It thus happens, particularly in the Maroochy district, that when an orchard borders a road the outside row of trees may become heavily infested with red scale, whereas this species is extremely rarely found further in the orchard. In the same way, on certain types of soil the lower limbs of trees may harbour larger populations of scale than those higher up, due to the accumulation of dust stirred up during cultivation. This has given rise to the idea that young scale are carried in dust, but this contention is erroneous.

Soil Factors.

From observations carried out over the last two years, it appears very possible that soil exerts some effect on the incidence of scale insects. Some very striking evidence has been collected, but the problem needs much more consideration before anything that is really definite can be given. However, it is of interest to note that in places trees on the same orchard growing on different types of soil carry different species of scales. Care has been taken to check the possible influence of other factors, and the final conclusion reached at times has been that soil variation has exerted considerable and limiting influence. This, of

course, is independent of the effective nutritional value properties of the particular soil—that is, the trees on both types have been in closely similar states of health and vigour.

The nutritional value of the soil is itself a most important factor, but the effect can best be considered in conjunction with plant factors. Apart from fertility, the moisture-holding capacity of a soil is important, and is at times a determining factor.

Plant Factors.

The state of health of a tree often determines the nature of the scale infestation it will carry. Thus an Emperor of Canton mandarin when in normal vigorous condition is very susceptible to infestation by pink wax. On unthrifty trees of this variety, however, pink wax may be of little or no importance, but mussel or red scale will then be commonly found to be present in large numbers. A healthy tree of this variety rarely carries appreciable infestations of either red or mussel except on the fruit under particular circumstances.

In the same way the health of any tree may be a determining factor in the matter of scale incidence—generally speaking, the more vigorous the tree the less scale it will carry. As the health of the tree is governed largely by soil conditions, presence of other pests, and diseases, all of these are of moment in the matter of scale incidence.

As might be expected, varietal susceptibility is also a consideration in this connection. At times, indeed, varietal characters are the determining ones, superseding even climatic influences. For example, it has been mentioned that the Emperor of Canton is very susceptible to pink wax. It will be found that trees of this variety growing in very dry parts where pink wax is ordinarily a rather rare insect may be heavily and habitually infested with this species.

Apart from influences which can be traced to specific causes, very often trees show individual characteristics with respect to scale insects the determining factors of which are not clear. Thus in one block of several hundred trees of one variety a small number scattered indiscriminately throughout the orchard may be persistently more heavily infested than the remainder, which may, in fact, be quite free of the scale. In some cases the trees may be obviously in different condition, a common cause being the bringing up of subsoil during preparation of the land, but in many cases there is no discernible difference between the attacked and free trees. It appears that the cause is to be found in the individual natures of the trees.

Natural Enemies.

The presence or absence of natural enemies of a species can greatly affect the success which it may meet in a particular locality or at a particular time, but as the effective enemies of the scale insects are well distributed throughout the country, it is seldom, if ever, that these natural enemies determine anything more than degree of infestation of a species. The only case in which incidence is likely to be affected is in the event of the arrival of a new species in a locality concurrently with the absence, or presence in overwhelming numbers, of natural enemies. Then, in the first eventuality, the new scale might become established with greater ease than would otherwise have been the case,

and in the second it might fail to gain hold in sufficient numbers to ensure continuation of infestation. As most of the natural enemies attack several species of citrus scales, this latter is possible, but it is nevertheless improbable and would almost certainly be of but a temporary nature. Natural enemies are of consequence in the matter of degree of infestation, and do not determine whether or no permanent infestation will actually occur.

THE ECONOMIC IMPORTANCE OF SCALE INSECTS AS PESTS OF CITRUS IN QUEENSLAND.

As a group the scale insects are the greatest limiting factor in the production of first-quality citrus fruit in Queensland, and that statement could probably be made of almost every country in the world. It is true that in almost every district in this State there is some pest or disease which causes growers more concern, at least over limited periods. Pests such as the bronze bug, *Rhœcocoris sulciventris* Stal., and the larger horned citrus bug, *Biprorulus bibax* Breddin, annually cause larger losses over restricted areas, and other pests such as the sucking moths may destroy larger quantities of fruit during limited periods in various districts, but the scale insects are of importance in practically every district at all times. There are fourteen species of scale insects found on citrus trees in Queensland, and of these all but five are of economic significance. Even with some of the five exceptions it would be unwise to assume that the economic status will always remain as it is now. Of the remaining nine species, seven are responsible for heavy losses in some parts every year, and apart from the status of the group, individual species are frequently the outstanding pests in particular parts. It is, however, as a group that these insects have to be considered. From what is recorded in connection with each species, it will be seen that there is scarcely a time or place that does not favour the development of some species of scale insect. Thus pink wax attacks vigorous trees, particularly in hot periods interrupted by good rains. Pulvinaria attacks vigorous trees, but is more in evidence in periods of rather milder temperatures, particularly in dry seasons. Red scale, on the other hand, thrives on weakened trees, particularly in the hot dry times, whilst should the trees be weak and the season one of high temperatures, together with fair humidity, mussel scale may be expected to make its presence felt. There is scarcely a commercial orchard in the State in which there are not several species of scale insects present, and, generally speaking, every tree harbours two or more. This, together with the breeding-grounds provided by trees outside the orchard in certain cases, ensures a nucleus from which an infestation may arise. Thus in almost any circumstances there is one species of scale which will menace the orchard. The insidious manner of working, together with the rapidity with which colonies increase, assists the species to take advantage quickly of suitable conditions and build up large populations before being detected, or at least before effective control measures can be taken.

Owing to the prolific and rapid reproduction of practically every species, the fight against scale insects is necessarily continuous, and in most of the major citrus-producing areas an orchardist who, by a single application of a scalicide, can keep his trees commercially free of these pests for more than one year is indeed fortunate, and, it may be added,

rare. In the case of at least one species—pink wax—even were elimination of all the individuals in an orchard possible at any one time, this would not ensure freedom from heavy attack for more than seven months at the longest.

That scale insects are so important as pests of citrus is due largely to the frequency with which remedial measures have to be applied, the destructiveness of many species, and the enormous numbers which are commonly present. This last factor is most important, for it means that to be at all efficient a scalicide must obtain a very high percentage kill to establish control lasting a reasonable period.

The status of each species will be considered in a later section in connection with the discussion on the habits of that species.

VERNACULAR AND SCIENTIFIC NAMES.

Naturally it is only by vernacular names that insect pests in general are known to orchardists. Whilst these suffice for most purposes, mistakes sometimes occur through unavoidable variation in these names in different parts of the State, and particularly in different countries. It very commonly happens that journals devoted to farming interests quote extracts on pests from overseas publications, and the rule in these cases is for such articles to refer to insects by vernacular names only. Costly errors have thus resulted in a number of cases, and as the practice is becoming more common, orchardists should be certain that they know exactly what insect is being discussed before making experiments, and the only way of doing this is by reference to the scientific name. Most Queensland citrus scale insects occur in other parts of the world, and many in every major citrus-producing country, and vernacular names not only differ in various countries, but the same or similar names are given to different species in different parts. The black scale of California, for example, is *Saissetia oleæ* (Bern.), which is Queensland's olive scale, whilst Queensland's only common black species, circular black, is *Chrysomphalus ficus* Ashm. In America this species, *C. ficus*, is called the Florida red scale, whilst Queensland's red scale is *Aonidiella aurantii*. The value of vernacular names is therefore obviously limited.

As regards the scientific names, these are unavoidably altered at times, and this may cause growers some confusion, especially when correlating information from books published at different times. Probably the outstanding case is with the old genus *Lecanium*. For many years a large number of the common Queensland scale insects were placed in this genus, and this is one of the few scientific names at all well known to citrus orchardists in this State. The subdivision of the *Lecanium* group into several smaller genera is thus unfortunate in some respects but must be accepted.

For the above reasons a brief account of the various important scientific names has been included, particularly those names which may be found in books readily accessible to orchardists. It may be helpful in this connection to note that in most cases it is only the generic name which has been changed. Thus the red scale has been generally known successively as *Aspidiotus aurantii*, *Chrysomphalus aurantii*, and *Aonidiella aurantii*, the specific name *aurantii* remaining constant.

PLATE 122.

Red Scale, *Aonidiella aurantii* (Maskell), showing infestation of fruit, foliage, and woody twigs.

RED SCALE.

The red scale, *Aonidiella aurantii* (Maskell), was first described by Maskell in 1878 from specimens taken from Australian citrus fruit imported into New Zealand. Maskell gave the insect the name *Aspidiotus aurantii*. The species was subsequently described under a number of other names, notably *A. coccineus* Gennadius, but the synonomy of these names was fairly quickly recognised. Later it was decided that the insect had been placed in the wrong genus, and experts for the most part were agreed that the correct genus was *Chrysomphalus*, and not *Aspidiotus*. More recently still the name has again been questioned, and from the most recent work it appears fairly certain that the correct naming is *Aonidiella aurantii*.

Description.

The pest (Plate 122) is common and generally well known to orchardists. The main characters by which it can be recognised by growers are as follow:—The scale of the female is circular with flattened margins and with the centre slightly raised. Owing to the fact that the scale itself is semi-transparent, the colour changes of the insect beneath affect the apparent colour, and though the actual colour of the scale is grey, it may appear grey, reddish-brown, or red. The scale is parchment-like in texture.

The young female is somewhat elongate and light yellow in colour, but later the extremity of the abdomen is modified in form, and the insect becomes sub-circular in outline. The colour generally becomes darker as the insect approaches maturity. The diameter of the female scale is approximately one-tenth of an inch.

The scale of the male resembles that of the female in texture and colour, though it is commonly lighter in shade in the case of the former. The male scale is elongate, and the convexity is found towards the anterior end instead of the centre as in the case of the female, the eccentric position being due to the addition of a "flap" at the posterior. In size the scale of a male pupa is scarcely half that of an adult female.

The adult male insect is light yellow in colour, with a conspicuous brownish band running transversally on the thorax. The remaining general characters conform to the description given in an earlier section for typical males.

Distribution and Habits.

The red scale is a notorious enemy of citrus in practically every country which produces that crop. It occurs throughout the tropics and subtropics, having been recorded from the United States of America, Southern Europe, Palestine, Egypt, South Africa, Ceylon, India, Japan, and China, as well as from many smaller countries. The original home of the insect is often given as Australia, but there is doubt on the point, and it is very possible that it is a native of the East.

The list of plants which the insect will attack is a long one, and includes apple, pear, banana, passion fruit, roses, and coconut palms. It is only as a citrus pest, however, that the species is of much moment. Though it attacks a number of indigenous Queensland plants, this is of little importance to citrus-growers, for the colonies in the forest and scrub are never an important source of infestation for citrus groves.

In Queensland the pest reaches its maximum intensity in the drier and hotter parts. In coastal districts south of Rockhampton, where the climate is more humid and the temperatures lower for the greater part of the year, red scale is not so severe a pest as it is in districts within the tropic or interior parts further south.

In every district this scale invariably becomes more important in abnormally dry periods than at other times. In these dry times there is always a very considerable increase in population, and the increase in damage is not due merely to the fact that the trees are then less able to withstand injury. The two factors certainly combine, and in such circumstances red scale commonly assumes the role of a major pest in areas where it is normally of little consequence. The increase in red scale populations in hot dry periods is sometimes attributed to a decline in the efficiency of natural enemies, particularly fungal parasites. All the evidence collected, however, shows that the increase is due mainly to the lower mortality rate of the young during such periods.

The state of the tree as regards health and vigour is also an important factor in determining the extent to which it will be attacked by this pest. Trees with impaired vigour are more susceptible to attack, not only in that they suffer more quickly, but in that they carry larger populations of the pest. The Emperor of Canton variety of mandarin is one which when healthy is rarely attacked to any extent by red scale, the pest in most instances, if present at all, being confined to immature fruit. When, however, it loses much vigour from disease or other cause an infestation of red scale frequently quickly follows. It appears that vigorous trees with a free flow of sap offer marked resistance to the pest, and, further, that on any tree the pest is less liable to become established on free-growing parts than elsewhere, for when trees of supple habit of growth are attacked, it is usual to find the insect confined, at least in the first instance and smaller infestations, to the more woody or weaker parts, where there is no great flush of sap.

Varietal susceptibility is in conformity with what might be expected from the foregoing. Thus lemons, which are more woody, are almost invariably infested, whilst the supple-growing mandarins are usually only troubled when other factors are operating strongly. Even in some very dry parts remote from the coast where the rainfall is very low, and where the available water cannot be used for irrigation, healthy mandarin trees quite free of red scale adjoin lemon trees which are persistently and heavily infested. Also in some of the wetter coastal districts small areas of lemons are sometimes included in an orchard, and though the red scale may be of no significance on the remainder of the trees, artificial control measures have to be applied against the red scale on the lemons. Most varieties of orange may be placed between lemons and mandarins in respect to habit of growth and also to the probability of attack by the red scale, and the placement is roughly quantitative.

The foregoing remarks apply essentially to well-grown trees. With young trees every variety appears to be very susceptible to this pest, particularly trees recently planted out from the nursery.

Red scale will infest all aerial portions of a citrus tree. When the foliage is heavy by far the largest numbers are generally to be found on more exposed parts—leaves, fruit, and twigs. On open and more scraggy trees, however, the limbs and main branches are commonly

found to carry large colonies of the pest, and it appears that red scale prefers positions exposed to sunlight. It is probably mainly on account of this preference that young trees are so frequently attacked, for in such cases little if any of the tree is effectively shaded.

Red scale is a voracious feeder, and no plant can long sustain the depredations of a large colony. Weakening and killing of leaves and twigs is accomplished rapidly, and young worked trees may be killed back to the union of bud and stock within a few months by colonies which could not be considered abnormally large. Even when actual death does not follow, the damage is often such that the tree never properly recovers. A tree which has been stunted during its early life by red scale, as many are, is rarely worth keeping.

On older trees, apart from the damage done directly by the pest, the trees may be so weakened that they are rendered very prone to attack by other insects, such as the borer *Uracanthus cryptophagus* Oll., and particularly by diseases such as melanose, *Phomopsis citri* Fawcett. Melanose is an ever-present menace to weakened trees in Queensland, and it is by the combination of red scale and melanose that a large percentage of older trees in the State are ultimately killed, or at least ruined.

The weakening effect of red scale on trees is overlooked in some instances. It happens frequently that an orchardist finds that some of his trees are heavily infested with red scale, and applies a spray against the pest. A short time later he notices dead wood appearing in the trees, accompanied by a heavy fall of leaves. He may at once condemn the spray material, overlooking the fact that the parts now dead were greatly weakened by the scale, and that almost any spray material would have completed their destruction. In fact, this would not have been long delayed even were no spray used. Whilst spray injury may have similar manifestations, and often does, every year perfectly good spray materials are condemned because orchardists do not take all the circumstances into consideration.

When infesting the fruit, though direct damage is done, in most cases the chief objection growers have to the scale is that the fruit must be cleaned before it is marketed, and the removal of red scale in large numbers is not very easily accomplished. The fruit must be brushed, and the extra handling, besides costing time and labour, always results in some loss of fruit through injury to the rind. The actual loss directly attributable to the brushing and handling may be small, but, particularly in some seasons and certain districts, the entrance of blue and green mould is greatly facilitated. The direct effects of feeding on the fruit are chiefly arrested development and reduction in size.

The female red scale does not lay eggs, but gives birth to living young. On emergence from the body of the mother the young "crawlers" remain for some little time beneath the scale of the parent. On leaving the protection of the scale the "crawlers" settle down in a very short time as a rule. In tests conducted on this point, it was found that under natural conditions "crawlers" at times had become fixed within thirty minutes of emergence from the scale, and that the great majority had settled by the end of eight hours. A few were found to move about for a whole day or more, but these were comparatively rare. The short duration of the period of crawling no doubt explains to a large extent the comparatively slow spread of the red scale from tree to tree. It

has often been observed that one tree may harbour a large population of red scale over a period of years, whilst surrounding trees remain practically free of the pest. Though other factors may operate, the slow spreading of the red scale was certainly the limiting factor in some instances. The scale is no doubt wind-blown to a certain extent, but it appears that this means of dispersion is less efficient with the red scale than with other species which have a longer crawling period.

The scale breeds freely on fruit stored after harvesting—a point which is of interest and importance to lemon-growers in particular, for the "crawlers" will migrate from fruit to fruit and from box to box. As lemons are commonly stored for fairly long periods, care must be taken to include no fruit carrying living scale in a storage lot.

Some writers infer that reproduction commonly takes place without the intervention of the male. Recent work by Nel,[15] however, shows that this is not to be assumed for California, and in so far as Queensland is concerned males are at all times sufficiently numerous to allow of reproduction being normally bisexual.

Life History.

Red scale young are produced practically continuously throughout the year under Queensland conditions. Even in the coldest weeks in winter young may be found, though at that time the number of "crawlers" seen is very small. It has been found that, though mortality in the winter is high, a proportion of the young then produced successfully establish themselves and reach maturity.

In experimental breeding work it was found that the life cycle occupied a period of little less than two months on the average. During January the average falls appreciably, and at this time some females commenced reproduction in as short as forty-eight days after emergence from beneath the mother scale. The life cycle in general, however, may be taken as approximately sixty days. As the young from each female are commonly found to emerge over a period of about fifty days, it would not be expected that any definition of generations would be found in the orchard, and it is difficult at any time during the warmer months of the year to find any suggestion of a dominant stage.

An experiment was conducted with a view to discovering the number of generations which might be expected in a year. In this work the progeny produced in the first six days by twenty selected females were kept under observation. In the same way the first progeny of the next and subsequent broods were used. It was found that with these individuals there occurred five generations in twelve months. This work was done under somewhat artificial conditions—lemon fruits encased in cheese cloth and hung on small trees being used. The artificial conditions may have had some influence on the results obtained, but it is thought that normally there are five broods each year. Observations suggest, however, that at times a partial sixth brood may appear.

CIRCULAR BLACK SCALE.

Early references to the circular black scale, *Chrysomphalus ficus* Ashm., will be found under the name *Aspidiotus ficus*. Ashmead described the insect as *Chrysomphalus ficus* in 1880, but subsequently the species was erroneously placed in the genus *Aspidiotus*. This error was rectified later, but for some time the specific name *aonidum* was used.

This name was widely accepted, but it appears that Linne's description cannot be definitely referred to this species, and Ashmead's name *Chrysomphalus ficus* therefore stands.

Description.

The scale of the female (Plate 123) is evenly rounded, and has the central portion raised similarly to that of red scale. The colour is purplish black or black with the central point surrounded by a reddish brown or brown band and the margins almost grey. The scale, like that of the red scale, is of parchment-like texture.

The crawlers are light yellow, and on becoming fixed are quickly hidden beneath a white waxy secretion. The well-grown female is rounded in front and tapers sharply towards the posterior end, the shape of the insect thus somewhat resembling that of a pear. The diameter of the female scale is one-twelfth of an inch.

The scale of the male is similar to that of the female, but is elongate and has the raised portion anterior to the centre. The male insect itself is typical of its class, and similar in general respects to the male red scale. The thoracic band of the circular black scale, however, is much darker in colour than in the case of the red scale.

It is characteristic of colonies of the circular black scale that the young settle down in very close proximity to the mother scale in many cases, and scales of many young may overlap that of the old female.

Distribution and Habits.

Circular black scale is widely distributed, and has been recorded from Florida, West Indies, Italy, Egypt, Ceylon, Japan, and Pacific Islands. Though common in many parts, it is not usually regarded as a serious pest of citrus, and is everywhere less feared than its close ally, the red scale.

There are a large number of plants from which this scale is recorded, the list including custard apple, mango, figs, Hibiscus, palms, and a number of indigenous trees. Like red scale, however, its presence on cultivated plants other than citrus does not cause much concern, and the native host plants rarely provide a material source of infestation to Queensland citrus groves.

In so far as citrus is concerned, though the species is distributed throughout the State, it is only in the hotter and drier parts that it can be regarded as a pest of importance. In more humid and milder climates such as at Tamborine Mountain or on the Blackall Range the species is rarely found on tended trees.

Although circular black scale thrives in the hotter localities, colonies as a rule are found in positions which are protected from much direct sunlight. Thus it is usual to find the pest mostly on the shaded side of the tree or on fruit or leaves well protected by overhanging foliage.

The insects do not become established on woodier parts, and are only rarely seen even on the most tender twigs. At all times of the year leaves are infested, but fruit is usually only attacked from the half-grown stage onwards. Even on lemon trees which are carrying a well-forward crop, the young of the generations hatching between winter and midsummer commonly infest only the foliage. It is the young of the third generation which migrate to the fruits—a fact which is of importance in connection with control.

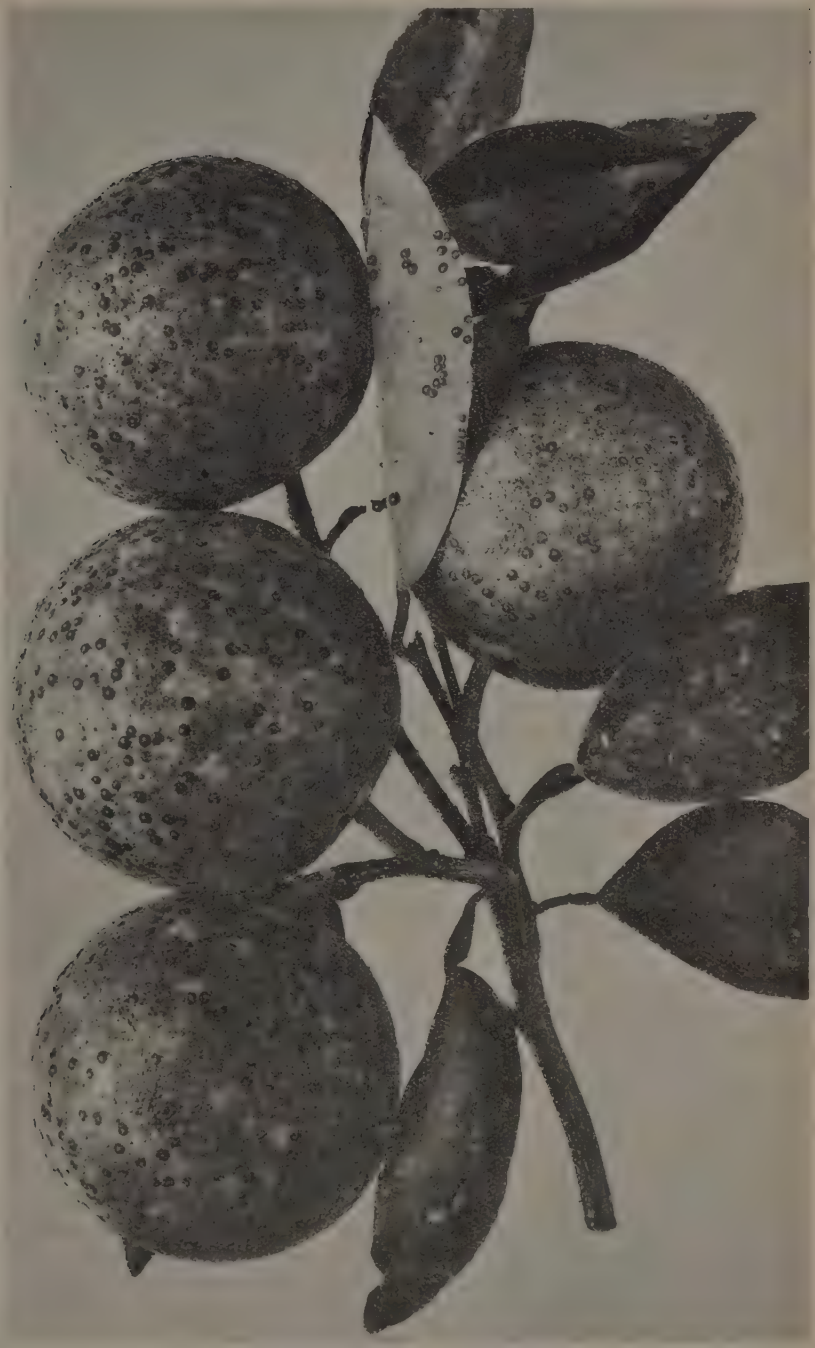

PLATE 123.

Circular Black Scale, *Chrysomphalus ficus* Ashm., showing the normal restriction of infestation to fruit and foliage.

The species cannot be considered a severe pest on the tree, and though marked shedding of the leaves may result, the health of a heavily infested tree does not appear to suffer greatly. The greatest objection to circular black scale as a rule is the disfiguration it causes to the fruit. The scale is particularly conspicuous on a yellow or orange background, and infested fruit must be thoroughly cleansed before being marketed. Apart from the disfiguration, when heavily infested a slight shrivelling of the rind may result, and in some cases retardation of maturation occurs. Younger trees are not often infested to any extent, but older trees of all varieties are attacked. More trouble is experienced by lemon-growers than others, but any variety of fruit which matures after mid-season may favour the development. For this reason mandarins are seldom attacked to any great extent, whilst oranges of late-maturing varieties, such as the Valencia Late, sometimes carry heavy populations of this pest. In particularly dry seasons, however, even the earliest maturing varieties of mandarins may need to be treated for an infestation.

Males of circular black scale are comparatively rare, and it appears that reproduction is normally parthenogenetic—that is, occurring without the intervention of the male. If such a mode of reproduction be normal, when both sexes combine the progeny are sometimes found to be of one sex only. This may account for the fact that at times colonies of circular black are found in which the males greatly predominate.

The adult females produce eggs which hatch very shortly after exclusion, giving rise to the minute, yellow crawlers, which may remain for two days or more beneath the scale of the mother insect. The free crawling stage is of short duration, sometimes not more than a few hours, and the young in many cases does not move any distance away from the site of hatching to settle down to feed. It is not uncommon to find as many as six young settled beneath the scale of the mother insect, and it would appear that this is due in part to the young experiencing difficulty in escaping. This multiple settling under old scales is most noticeable on the fruit, and in tests of scalicides it was found that in every instance where sprays were employed the kill on the fruit was considerably lower than on the leaves. It appears that on the fruit, particularly at times when eggs are being laid, the adult female keeps very firm contact with the surface. This habit of becoming fixed in close proximity to the old insect at times acts to the detriment of the pest, for leaves injured by the insect and shed prematurely may carry large numbers of quite young scales, which are thus removed from the tree with very little, if any, possibility of returning. Migration from tree to tree is much more pronounced with this species than with the red scale, though the spread through an orchard is still very slow.

Life History.

The winter is passed in immature stages, and the first young following this season are to be found about the beginning of September. Though from this time throughout the warmer months young are constantly produced, overlapping of generations does not occur to a very great extent, and while representatives of all ages may be present on any tree, it is usual to find that the great majority of individuals are of approximately the same age, except towards the end of summer, when, as would be expected, overlapping is more pronounced.

The brood produced in September reaches maturity toward the end of the following month or early in November, and a second generation is at once commenced. The development of this second brood occupies November and December, and at about the end of the year—or more typically, early in the new year—a third generation makes its appearance. This third brood infests the trees from January to about the beginning of March, and, as has been mentioned above, it is the young of this brood that first migrate to the fruit. Early in March the fourth generation begins to emerge. The emergence of young of this fourth brood continues over a much longer period than in the case of any other, and consequently there is a greater diversity of stages then than at any previous period. The fourth generation is composed of those individuals which persist through the winter and reproduce again in the following September. The prolonged period of hatching is due to the variation in developmental periods in different individuals of previous generations more than to the fact that the period of fecundity of the females may be prolonged at that time of the year. Owing to the variation in size and evident age of the insects during the winter, the idea is sometimes held that a fifth main hatching takes place during the cold months. This impression is strengthened by the fact that even in the coldest times young crawlers may be found beneath old scales. However, close observation was kept on several hundred females known to be of the fourth generation which hatched at the average time, and these did not reproduce until September. As regards the young which are sometimes found in the winter, these are few in number, and, further, from tests conducted it appears very unlikely that any appreciable proportion of them survives the cold weather. In tests carried out at Nambour the mortality of young emerging between the second week in June and the beginning of August was almost 100 per cent. The effective, and in all probability the actual, number of generations per year then is four.

In the experimental breeding work during the past three years the actual time required for the development of females from emergence from beneath the scale of the mother to the production of young was found to be remarkably constant during the warmer months, the variation for by far the greatest number of insects being but two days—viz., sixty-four to sixty-six days. Small numbers may take either a little less or a little more time, and the shortest period taken was fifty-eight days during February and March, 1931.

MUSSEL SCALE.

For some time mussel scale, *Lepidosaphes beckii* (Newm.), was known as *Aspidiotus citricola,* the name under which it was described by Packard in 1870. A few years later it was transferred to the genus *Mytilaspis,* as defined by Signoret, and it was under that generic name that much of what has been written of the scale in Australia appeared. Later work, however, elucidated the fact that Newman had described the species a year earlier than Packard, and therefore Newman's specific name *beckii* precedes *citricola.* The correct genus has also been found to be neither *Aspidiotus* nor *Mytilaspis* but *Lepidosaphes.* As most of the older Australian books give the name as *Mytilaspis citricola,* the change to *Lepidosaphes beckii* may be confusing.

Description.

The scale (Plate 124) of the female is purple, or in older specimens almost a drab brown. The surface is somewhat roughened. The cast skins or pellicles are conspicuous at the anterior end as a lighter area, though in very old specimens these may be a dark brown instead of reddish, as they more normally are. The margins of the scale are whitish. The scale is elongate, slender, and somewhat mussel-shaped, the sides curved, and the whole convex. The texture is similar to that of the red scale, but in the case of mussel scale is thicker and more leathery.

The adult female is creamy white with the last segment of the abdomen reddish. The body is considerably broadened at the posterior end, and the segmentation of the abdomen is well defined. Beneath is a ventral scale which is entire over the body of the insect. This scale is white and is very easily ruptured. The eggs are laid in irregular formation, and as each egg is produced the female shrinks up towards the anterior, so that finally almost the whole of the space under the scale is filled with the eggs. The length of the female scale is one-tenth to one-eighth of an inch.

The scale of the male is similar in general respects to that of the female, but is smaller, less curved, and rather lighter in colour. The adult male is of the typical winged form.

Many growers style *L. beckii* Glover scale, but though the species are similar they are distinct. Glover scale is very closely allied, but is *L. gloveri* Packard. This species differs from *L. beckii* in that the ventral scale of the former is divided and the eggs, instead of being irregularly arranged, are set in two parallel rows. The female scale of Glover scale is narrower than mussel, and also has the sides straighter. W. W. Froggatt records Glover scale from Victoria and New South Wales, and H. Tryon[16] has recorded it from Queensland on citrus. There are a few dried specimens in the departmental collection labelled Glover scale as from citrus in Queensland. Definite identification of these specimens cannot now be undertaken, however. During the course of this investigation no Glover scale has been found on citrus in Queensland, and if the species attacks citrus in this State it must be very rare. It is probable then that when growers are under the impression that their trees are infested with Glover scale the species is actually mussel.

Distribution and Habits.

Green[1] states that mussel scale is found almost wherever any species of citrus is cultivated. It is common throughout the citrus districts of this State, and though it has been recorded from a number of indigenous hosts, these do not constitute breeding-grounds capable of providing appreciable infestations to citrus orchards. In Queensland the mussel scale is primarily a pest of the coastal parts, and it appears that the low humidities commonly experienced in more inland regions act to the detriment of the pest. In coastal areas the mussel scale is comparable to the red scale in interior parts as a pest of citrus. The damage to the trees is severe and follows rapidly on the occurrence of large populations. Fruit, leaves, twigs, and branches up to an inch in diameter or even larger are attacked. The fruit is usually not attacked until it is fairly well developed, and though a few individuals may be found on them in early January, it is usually not until about the beginning of March that appreciable numbers occur there. On the fruit

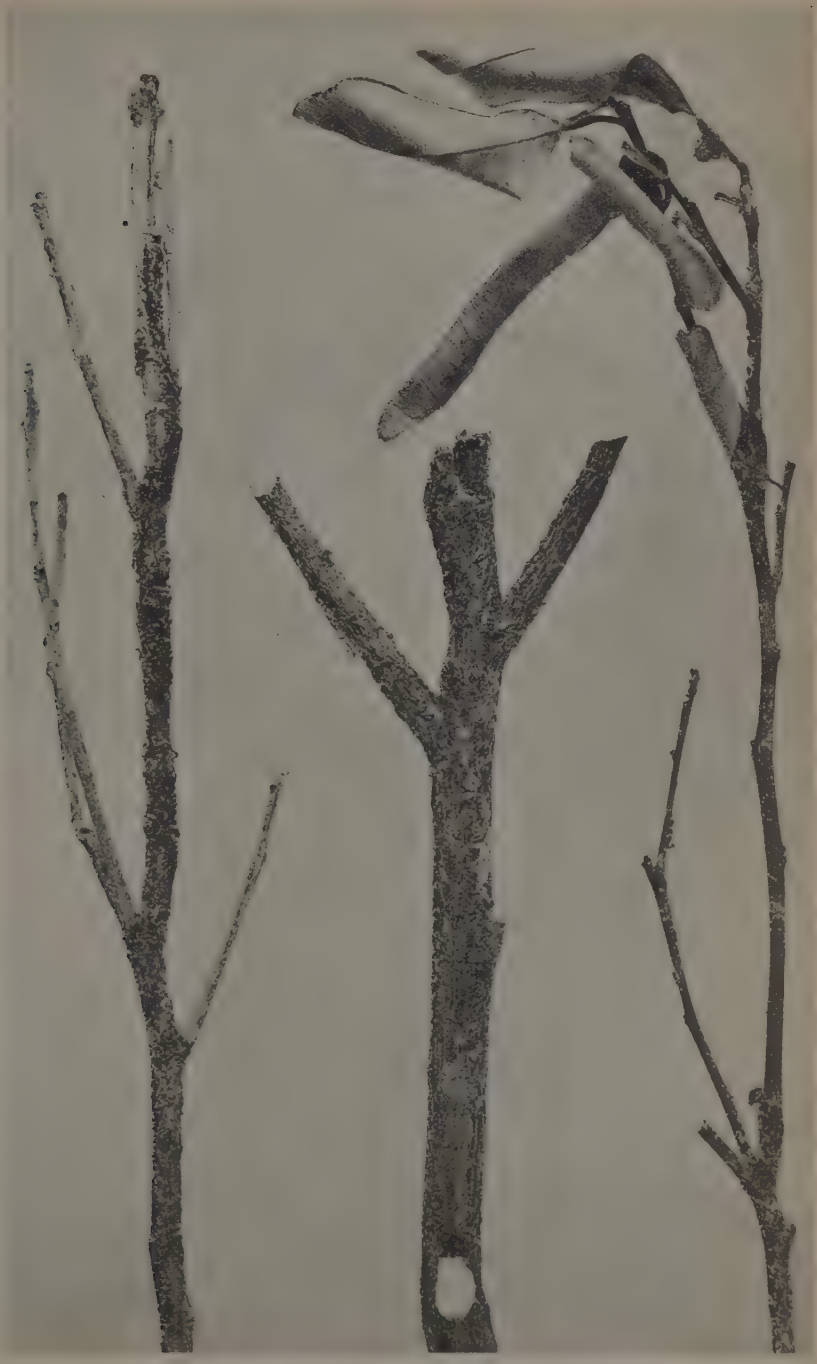

PLATE 124.

Mussel Scale, *Lepidosaphes beckii* (Newm.), showing infestation of woody parts and resultant death of twigs.

the most favoured sites for feeding are at the stem end against the "button," or, if the fruit be clustered, around the points of contact of the two fruit (Plate 125). Later the colonies extend to any part of the fruit, and dehydration of the rind commonly ensues. If the infestation at the stem end be at all heavy premature yellowing and dropping may result. As well as the direct injury caused by feeding, mussel scale is most objectionable on the fruit, as it is disfiguring and is most difficult to remove by brushing. This scale is a much more difficult one to remove than the red or the circular black scales. Healthy tender twigs are not often attacked, but more woody twigs or those of harsh growth support the largest colonies. Small twigs which support the pest quickly lose vigour, and the scale gradually works its way back along these weakened parts. Such twigs are usually quickly killed by the scale alone, but larger parts generally survive long enough to become infested with melanose or some other such malady, and death is finally brought about by the combination of the scale and that disease. Melanose is very commonly associated with this scale in the more humid parts of the State. Young leaves do not usually harbour the pest, but older leaves, particularly those inside the tree which are protected to some extent, are prone to attack.

It is characteristic of the young to settle down shortly after emergence, and commonly they do not migrate any further from the mother scale than is necessary to find a clear portion of the plant surface. Thus colonies are typically so closely crowded that the scales of all individuals touch or overlap each other, even though there be an abundance of suitable feeding sites within a radius of less than an inch. On woody parts the colonies may be so dense as to form an incrustation completely covering the bark. Such an incrustation may extend from the limit of hardened growth or living tissue back a foot or eighteen inches along the branch. The species does not spread very quickly through an orchard under ordinary conditions, and one or a few trees may carry large colonies for a considerable time before appreciable numbers are found on neighbouring trees. However, when suitable conditions prevail on any tree an infestation quickly follows.

All commercially-grown varieties of citrus are susceptible, but mandarins usually carry more individuals than comparable oranges. Lemons are infested heavily at times, but are seemingly much less attractive than mandarins or oranges. On healthy trees mussel scale in appreciable numbers is usually confined to the immature fruits. The species is, however, essentially a pest of weakened trees. Mussel scale is second only to red scale in importance as a citrus scale pest in Queensland, and as will be seen by comparison, the two species have much in common, the one predominating in coastal parts and the other in the interior.

Life History.

In experimental breeding work it was found that during the warmer months of the year females may produce eggs within about sixty days after emergence. The great majority of individuals, however, require about sixty-five to sixty-seven days in which to complete the life cycle. Eggs are produced throughout the year, and with no other species found on citrus is effective winter reproduction so pronounced. Even in the coldest times the crawlers are able to become established and natural mortality in the winter is not at all high.

PLATE 125.

Mussel Scale, *Lepidosaphes beckii* (Newn.), showing infestation of fruits at point of contact and at stem ends.

A month may elapse between the times of hatching of the first and the last egg produced by one female, and thus there is no defined succession of generations. At only one period of the year is any suggestion of a pure brood to be observed. This occurs at times during February, and at this time colonies are frequently found in which almost every individual is of approximately the same age—adult females just ready to lay or laying. From this it would appear possible that the typical hot dry January weather is responsible for a high mortality of young. It is probably on account of this also that the insect is relatively unimportant in interior districts.

From the period occupied in completing the life cycle it appears probable that there are four generations each year.

WHITE LOUSE.

When first examined, White Louse, *Chionaspis citri* Comstock, was not recognised as a distinct species, but was included by Comstock in the species *Chionaspis euonymi*. Comstock, however, observed certain differences, and in 1883 he described this insect as a separate species, and gave it the name of *Chionaspis citri*.

Description.

The scale of the female (Plate 121, fig. 2) is a dull brown or almost black colour, with grey margins, and with the brown or yellowish pellicles rather prominent at the anterior end. The shape is somewhat similar to that of the mussel scale, but the curving of the sides is much less pronounced or may be quite absent, and instead of being regularly convex, along the central line there is a ridge from which the sides slope away to the margins. The scale, which appears comparatively thick, is parchment-like in texture, and is commonly covered with minute particles of dust which adhere readily to it. The adult female (Plate 121, fig. 3) is creamy coloured, elongate in outline, and has the abdomen rather deeply segmented. The scale of the male (Plate 121, fig. 4) is white and carries three distinct longitudinal ridges along practically its whole length. The pellicles, when fresh, are yellowish, but later turn brown and are not readily seen unless the insect be removed from the plant. The adult male (Plate 121, fig. 6) has a light-yellowish body, and is normal in general form. The crawlers are elongate, yellowish in colour, and rather more robust-looking than in most other species. The length of the female scale is one-sixteenth of an inch, and of the male scale one-twenty-fifth of an inch.

Distribution and Habits.

White louse was originally obtained on orange trees in Louisiana and Cuba, and it is considered probable that it was imported into New Zealand and Australia from America. In Queensland the species is common in all parts where citrus is grown, and citrus appears to be the only host plant which has been recorded, either in Australia or elsewhere.

White louse differs from all other citrus scales in Queensland in that the males are much more in evidence than the females, and growers are very seldom familiar with the latter sex of this species. The young seek depressions in the bark in which to settle, and the females adhere very closely to the host plant. As they are commonly covered with dust

and other foreign matter and their colour harmonises with that of unhealthy bark, it is often rather difficult to find the females. The males are not only more conspicuous in themselves but are always abundant, the males commonly many times outnumbering the females. A heavily-infested tree may appear from a little distance to have been whitewashed, but even the closest examination of such a tree without a hand lens will possibly not disclose the whereabouts of a single female. That the vernacular name should be derived from the appearance of the male is therefore not surprising though rather extraordinary.

The white louse thrives in many different climates, and temperature does not appear to exert any marked effect on the degree of intensity of infestation. Humidity, however, does seem to be of importance, and in any district the pest is much more in evidence in dry than in wet times.

All aerial parts of the tree are affected, but the white louse is essentially a pest of the trunk and main limbs. Infestation usually commences on the trunk a foot or two from the ground and spreads upwards. On the trunk and main branches, attacked bark becomes hard and dark in colour, and the tree presents a hidebound appearance. Vigorous trees carrying large colonies usually show a cracking of infested bark. These cracks may serve as a point of entrance for the borers *Symphyletes sodalis* Pasc. and *Uracanthus cryptophagus* Oll., or other detrimental organisms. Gumming commonly results when the bark splits, particularly if this happens low down on the tree.

Fruit, leaves, and twigs are also susceptible to attack, but white louse is seldom found on these parts of tended trees. The extent to which the scale will disperse through the tree is governed to a very large extent by the general health of the tree, the less vigorous the tree the further the scale penetrates from the trunk. Leaves and twigs may be badly damaged, but white louse does not bring about the death of these parts with anything like the rapidity of red or mussel scales. Whilst the fruit is rendered unsightly by the presence of the scale, this is rarely of importance, as, if an appreciable proportion of the fruit carry the insect the trees are so unthrifty that the total crop will certainly be small.

All varieties of citrus are attacked, but mandarins as a rule do not harbour nearly as many individuals as comparable lemon or orange trees. Young trees are seldom attacked to any extent. That the scale is not of greater importance is due mainly to the fact that it is fairly easily controlled. The conspicuous males ensure that attention will be drawn to colonies before these become very large. The damage to the trunk, however, is often such that orchardists must regard this species as potentially a very bad pest. The small amount of damage done at times by very large colonies is no doubt due to the fact that the females may form but a very small portion of the population.

Life History.

Under orchard conditions in Queensland white louse breeds practically continuously throughout the year. Young may always be found, though the number present in the winter is small, and mortality at that time high. In experimental breeding work females required on the average about sixty-five days in which to complete their development. As young may be produced by any one female over a period of from three to six weeks, there is no clearly defined succession of generations. A fairly large hatch is noticeable early in September, but apart from

this, under field conditions the seasonal life history is featureless, and little assistance in the matter of control is to be gained by a detailed knowledge of it. From experimental breeding work in which selected individuals of each brood were used, five generations were secured in twelve months, and from this and field observations it appears that there are ordinarily five generations, four of which are large and the fifth (that occurring in the autumn and winter months) small.

HEMISPHERICAL SCALE.

The hemispherical scale, *Saissetia hemispherica* (Targ.), was first described by Targioni-Tozetti in 1867. Originally it was placed in the genus *Lecanium*, and under that generic name it became widely known both to entomologists and agriculturists. The old genus *Lecanium* has now been divided into several smaller genera, and the hemispherical scale has been placed in that section now known as the genus *Saissetia*.

Description.

The species (Plate 126, fig. 6) is easily distinguished from the other citrus scale insects. The recently-hatched young are very pale-yellow and active, possessing well developed legs and antennæ. When first settled, the young females are only very slightly convex, but gradually become more so until finally, by the time maturity is reached, the shape is almost hemispherical with narrow flattened margins. The recently-settled young are light brown, and as development proceeds the dorsal or upper surface darkens and ultimately is shining brown or reddish brown. In immature stages three ridges on the dorsal surface intersect to form an elevated "H," but later this marking disappears, and in full-grown specimens the surface is quite smooth. This "H" varies in prominence—in some individuals it is very distinct, whilst in others it is scarcely discernible. Seen under a hand lens the dorsal surface has a marbled appearance, due to the fact that the thickening of the derm is not uniform. The female insect does not secrete a scale, but remains naked throughout life. The thickened dorsal derm, however, somewhat resembles a true scale in appearance.

On completion of egg-laying the mother insect dies and quickly dries out, and the body is drawn up against the dorsal derm. On removal from the plant it is found that the insect has become merely a hollow hemispherical-shaped shell, beneath which is a space loosely filled with a mass of minute, white eggs. The female scale is very variable in size, the average length being about one-tenth of an inch.

The male insect is at first naked and cannot be distinguished from the female. After the second moult, however, the males secrete a true scale which is transparent and of glassy appearance. The male hemispherical scale is rarely found in Queensland.

Distribution and Habits.

The insect is very widely distributed, and has been recorded from practically every civilised country. Throughout the tropics, it is common on a very large number of plants under natural conditions, and in temperate and colder parts it becomes a pest in greenhouses. The list of host plants is long and comprehensive, including as it does species from

many families of plants. Coffee, custard apple, crotons, gardenia, chrysanthemums, and several kinds of fern are some of the cultivated plants which the insect will attack.

Hemispherical scale is to be found in every major citrus-producing district in the State, but it is seldom that it becomes a pest of any importance. It reaches its maximum intensity in coastal parts, and the heaviest infestations occur on the Blackall Range, but even there it is confined in large populations to but a few orchards at any one time, and then only a small proportion of the trees are affected in the great majority of cases.

In settling down the young usually choose the very young soft twigs, and the insects are very rarely found on growth that is at all hardened. After settling down to feed the insects do not move again until the time of reproduction approaches. Then the females may migrate from the twigs to the leaves, or less often to the fruits. When small colonies only are on a tree the presence of an infestation may remain unobserved during the larval period, for the very young make use of any depression, and later the colour harmonises well with that of the twigs. However, the habit of the adult females of migrating may disclose their presence at about the time of reproduction, for they are then larger and take up exposed positions.

Large colonies of the insect may be accompanied by a growth of sooty mould, but the presence of this fungus is not a characteristic of the species, and very large colonies may be quite free of any such growth.

All varieties of commercial citrus are attacked, and though lemons are seldom found to carry an appreciable number of the pest, this is probably due to factors other than varietal ones. Beauty of Glen Retreat mandarins appear to be rather more favoured than any other commonly grown variety. Irrespective of variety the largest populations occur on trees two to four years old, which carry abundant foliage and much tender growth. Even on these trees the amount of injury sustained is rarely of any moment, and only exceedingly heavy infestations need cause concern. The species is, then, of little economic importance, though there are occasions when it becomes necessary to apply artificial measures against the pest.

Life History.

The hemispherical scale completes its life cycle rather more quickly than do most other species of citrus scales. The period elapsing between egg-hatching and production of eggs for the following generation varies in most individuals from forty-eight to fifty-six days during the warmer months. The insects over-winter in immature stages. Maturity is reached during September by most of the over-wintering females, and there is usually a large hatch of eggs during the second fortnight of that month. Following this, other main hatches occur as a rule in early November, late December, in February, and again in March or early April. There are thus five main broods each year. However, at almost any time other than towards the middle of winter, eggs, and therefore after November, all stages, of the insect may be found. The main broods are, however, usually well defined, and when a large colony is found the great majority of the individuals are in the same stage of development, and this stage will generally be found to be that which would be expected from the times given above in connection with main hatchings. This

is so because the rate of development of individuals from any one batch of eggs is fairly uniform. Large populations are built up only in abnormal circumstances, which circumstances are naturally quite temporary, and unless the effect is felt by the large majority of individuals in the colony, it will not be far reaching. The hemispherical scale is kept in check to a very large extent by natural enemies, and the abnormal circumstance is usually the failure of an effective parasite. In the case of small colonies the individuals are usually in the same stage of development, though they may differ greatly from the average for the species.

OLIVE SCALE.

The olive scale, *Saissetia oleæ* (Bern.), was first described by Bernard in 1782 under the name of *Chermes oleæ*. From time to time since then it has been placed in several genera, but the only other name under which much has been written of the species is *Lecanium oleæ*. As has been mentioned above in connection with the hemispherical scale, the genus *Lecanium* has been redefined, and this species is now in consequence known as *Saissetia oleæ*.

Description.

There has been a great deal of confusion in Queensland in connection with this scale (Plate 126, fig. 5), and orchardists and others commonly refer to the hemispherical scale as the olive scale. Though the two species are closely allied, there is not much similarity in general appearance, and it is difficult to account for the error. The description of this species should be checked against that for the hemispherical scale in any case of field identification.

The adult female is brownish-black, or under Queensland conditions almost quite black, with a little speckling of white. The outline is roughly oval and the margins are irregular. The surface is roughened, and there is a persistent and prominent "H" marking on the dorsal surface. It will be noted that in the hemispherical scale this "H" marking disappears before maturity, whilst in the olive scale it is present in the adult females. The female is strongly convex, but does not present the regular hemispherical shape typical of its ally, *S. hemispherica*. The length of the female scale is about one-seventh of an inch. The male has not been found in Queensland.

Distribution and Habits.

Olive scale is widely distributed throughout the world, having been recorded from Europe, South Africa, Ceylon, the United States of America, and other smaller countries. It appears, however, to be of more importance in temperate than in tropical countries. In the course of recent investigations the species has been found in the south-eastern portion only of Queensland. It may, of course, occur in other parts of the State on other plants, or citrus in small centres of production, but if so it would appear to be uncommon on them. The scale attacks numerous plants, both cultivated and wild, but it is oldom a pest of importance on any host. The best-known host plants are olive, rose, figs, guava, and some species of deciduous fruit trees. In so far as citrus in Queensland is concerned, the species is of no importance whatever. In the course of the last five years only about thirty small colonies have been found

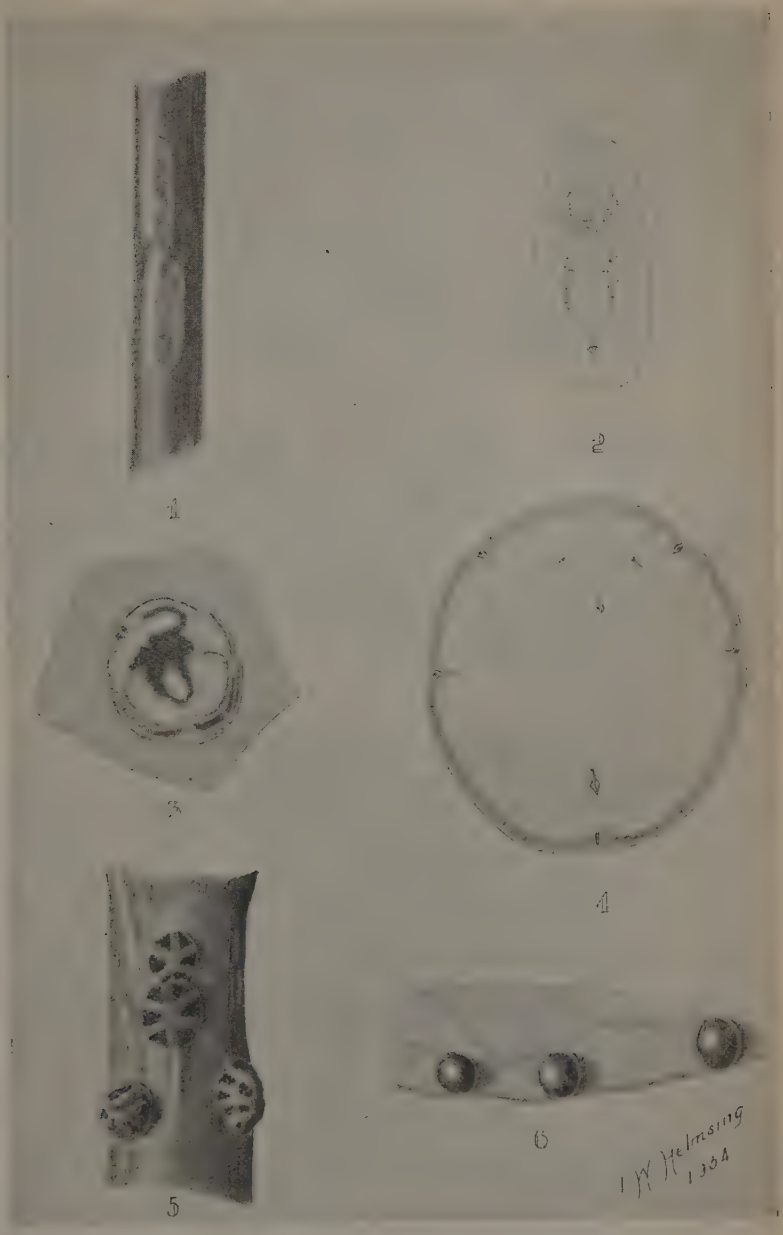

PLATE 126.

Fig. 1, Long Soft Scale, *Coccus longulus* (Douglas), on stem × 3. Fig. 2, Microscope mount of Long Soft Scale × 8. Fig. 3, Flat Scale, *Paralecanium expansum* (Green), on leaf × 3. Fig. 4, Microscope mount of Flat Scale × 8. Fig. 5, Olive Scale, *Saissetia oleæ* (Bern.) × 3. Fig. 6, Hemispherical Scale, *Saissetia hemispherica* (Targ.) on leaf × 3.

on citrus in this State. Under these circumstances very little work has been done on the pest. Attempts were made to establish colonies on laboratory trees without success. From accounts given by Quayle (5), Woglum (6), and others, of the pest in the United States, it appears that in California this species rivals red scale in importance as a pest of citrus. This is due, no doubt, in part to the fact that in certain areas in that country *Saissetia oleæ* is resistant to cyanide. A sooty mould fungus accompanies colonies of the pest, and this adds to the injury suffered by citrus-growers affected by this species. Quayle states that high summer temperatures limit the distribution of the species in California, and this may be largely the cause of the unimportance of the insect in Queensland. From the limited observations possible in this State it appears that, though the insect is to be found on succulent parts, it will attack parts much more woody than the hemispherical scale.

Life History.

As has been mentioned, in view of the status of the species in this State, very little work has been done on this insect and the life history under Queensland conditions is not known. Quayle states that normally in most districts in California there is but one brood each year, the main egg-laying period being in mid-summer (corresponding to November, December, and January in Queensland). The same writer states that irregular hatchings occur in his country, and from field observations on a very limited number of specimens it would appear that irregular hatchings are a feature of the life history in this State also, if there be but one brood per year here.

SOFT BROWN SCALE.

The soft brown scale, *Coccus hesperidum* (Linn.), has been known for a very long time, having been described by Linnæus in 1735. Since that time it has been given more than a dozen names, but *Lecanium hesperidum* is the only one of these of much interest. It is under this generic name that the species is most widely known in Queensland, but this no longer stands, and the insect is correctly called *Coccus hesperidum*.

The minute crawlers are pale-green or yellowish-green, and are elongate oval in shape. They do not as a rule migrate far from the site at which they were produced, and thus colonies may persist in one small portion of a tree for a long period without the infestation spreading to other parts of the tree. The immature settled females are flat, naked, and rather yellowish in colour. The adult females are somewhat convex, and are roughly oval in shape, though rather longer than broad. The colour varies from yellowish-green to very dark-brown. Under a hand lens the dorsal surface is seen to be marked with numerous brown dots, which at times may form ill-defined and somewhat wavy lines. In all but the darkest specimens the eyes are conspicuous as brown or black points situated close to the margins at the anterior end. The scale is very commonly parasitised in Queensland, and the presence of internal parasites in the body may affect the colour of the scale insect. Thus a colony rarely presents a uniform appearance as regards colouration. The length of the female is one-eighth of an inch.

Distribution and Habits.

The soft brown scale is widely distributed throughout the world, having been recorded from Europe, North and South Africa, Japan, Ceylon, North America, Brazil, and other countries. In Queensland the species appears to be confined to the southern portions of the State remote from the tropic. The insect has been recorded as attacking many plants both cultivated and wild in other countries. W. W. Froggatt[12] states that it occurs on many cultivated plants, and even native shrubs in Australia. In the course of this investigation it has been taken on only one indigenous plant—namely, river cherry (*Eugenia* sp.). A few individual scales closely resembling *C. hesperidum* were found on *Hibiscus heterophyllus* Vent., but the specimens, all of which were parasitised, were not suitable for definite identification. At all events the question of native hosts has no bearing on the control of the scale on citrus.

The scale is a very rare one in citrus orchards in this State, and though on occasions isolated large colonies may be found, these are very soon attacked by natural enemies, and never persist longer than one generation. Soft brown scale feeds only on the most tender parts of the tree, and mandarins appear to be more favourable to the insect than other varieties. Even the heaviest infestations so far encountered in this State, however, have been cases in which a few twigs on but one or two trees in an orchard were affected, and the scale is of little consequence from an economic point of view. Under present conditions growers need not be concerned about it as a pest of citrus.

Life History.

Under the circumstances little work has been done on the life history of the species. Colonies were established under experimental conditions for observations, but the percentage parasitism of these colonies was always so high that very few individuals could be used in this work. The time taken for the completion of the life cycle by those females which escaped parasitisation varied from sixty-one to sixty-seven days during the warmer months. From this and other observations it seems that there are normally four generations per year. The late summer generation appears to be the largest, but from February onwards the parasites are particularly numerous, and any great increase in population is thus unlikely even at that period of the year. From the very limited field observations it appears that generations are fairly well defined, and that no considerable irregular hatchings take place.

LONG SOFT SCALE.

Long soft scale, *Coccus longulus* (Douglas), was originally described by Douglas in 1887 and given the name *Lecanium longulum*. It was known under this name for many years, but when the division of the genus *Lecanium* was brought about this species became part of the genus *Coccus*.

Description.

The crawlers are elongate, light-coloured creatures which move very quickly about the plant before settling down to feed. The female (Plate 126, fig. 1) does not secrete a scale, and though the dorsal derm is thickened the insects are quite soft until reproduction commences when

the derm appears rather scale-like, and tougher, but even then it is by no means hard. The general colour is light-brown, or at times somewhat yellowish, with the margins darker than the remainder. The eyes can be observed as dark spots situated towards the anterior end and near the margins. The scale is convex and presents the appearance of a half-cylinder with the edges flattened. Newstead[7] records that some specimens resemble very much the soft brown scale (*C. hesperidum*), but this has not been observed in Queensland specimens, and the scale can be easily distinguished from all other citrus scales in this State by its light colour in conjunction with its long narrow shape. The male of the species has not been observed in Queensland. The length of the female is one-fifth of an inch.

Distribution and Habits.

The long soft scale has been recorded from England (on exotic plants), Massachusetts (U.S.A.), Pacific Islands, Ceylon, and other parts. In Queensland it is rarely found on citrus except in tropical districts, where at times it becomes plentiful. The heaviest infestations so far observed were at Yeppoon and Bouldercombe, in the Rockhampton area, whilst appreciable numbers may at times be found on isolated trees at Gayndah. Apart from citrus, the only plant on which the scale has been found in the course of these investigations was custard apple. Several other host plants have been listed in other countries, and though the scale possibly infests these or allied trees in Queensland, the existence of alternative hosts is of little importance to local citrus-growers. It is of interest to note that the long soft scale may frequently be found on custard apples in regions much further south than those in which only an odd individual has been seen on citrus, even though this latter host be growing in the same locality. Dry seasons appear to favour the insect.

The young settle down on tender twigs, and the remainder of the life of the female is spent there for the most part. However, reproducing adults may be found on the leaves always close to the midrib, and it appears that such individuals migrate to the leaves just before reproduction is commenced. The presence of a colony is usually denoted by a copious growth of sooty mould, and in all cases noted the presence of this fungus has been the most objectionable feature of the infestation. The insect itself apparently does not affect the tree to any marked extent, and the amount of injury following even quite heavy infestations is slight.

Mandarins are the only trees on which any large colonies have been found, and it appears that the Emperor of Canton variety is the most preferred of those commonly found in Queensland orchards. As will be mentioned later, the pink wax scale also commonly infests this variety of tree, and it is of interest to note that in no case have both of these species been found in appreciable numbers on the one tree. In quite a number of places where pink wax has been found thickly infesting surrounding trees, those carrying the long soft species were either almost or quite free of the former species.

Life History.

All attempts to establish colonies of the long soft scale on experimental trees at Nambour have failed. The failure may have been due in part to unsuitable climatic conditions, but possibly the same factor which influences the incidence of the species on certain trees as outlined above

was also operating. The information on the life history, then, is confined to what has been obtained from field observations. The broods appear to be distinct, and reproducing females have been found in November, late January, and late March. From this it would appear that a fourth hatching might occur in or about September. This, however, has not actually been observed. It is considered very probable, however, that the insect completes four generations each year.

FLAT SCALE.

The flat scale, *Paralecanium expansum,* was described by Green in 1896 as *Lecanium expansum,* the generic name becoming *Paralecanium* when the division of the larger genus took place.

Description.

The scale (Plate 126, fig. 3) is quite different in appearance from all other species occurring on citrus in this State, and there is no likelihood of any confusion in identification. The immature females are so flat as to appear as merely a single thickened tissue on the surface of the leaf, and even the adults at the time of reproduction are only very slightly convex. The adult female is almost circular in outline, but is slightly longer than broad and somewhat tapering to the anterior end. The regularity of outline is broken by two indentations on each side, and one at the posterior end known as the anal cleft. The colour is brown or green, with the margins darker. Owing to the flatness and the harmony of the colours with that of the leaf surface, the scale is not very readily observed on the plant. The length of the female is one-fifth of an inch. The male has not been observed in Queensland.

Distribution and Habits.

The species appears to have been taken only in Ceylon and Queensland. Green[1] records it from Dalbergia and Litsea in the former country, and W. W. Froggatt[2] states that he obtained it on Moreton Bay fig at Maryborough (Queensland). The only specimens obtained from citrus were taken in the Cooroy district, and this appears to be the first record of the insect from that host. It is not common even in the Cooroy district, and information on the species as a citrus-feeding insect is therefore very slight. Both surfaces of the leaves are chosen as feeding-grounds, and the insects settle on the blade and not necessarily close to the midrib. Froggatt noted that sooty mould was associated with the species at Maryborough, but in the light infestations seen at Cooroy this fungus was not present. Parasites of the scale appear to be fairly active, and none of the affected trees suffered appreciable injury over a period of two years when carrying light infestations.

Life History.

No work has been possible on the life history, and beyond the fact that young emerged in April, 1932, and did not mature before June of that year, nothing is known of the breeding of the insect.

PULVINARIA SCALE.

Pulvinaria scale, *Pulvinaria cellulosa,* was described by Green[1] in "The Coccidæ of Ceylon," Part IV.; there does not appear to be any known synonyms of this name.

Description.

The young (Plate 127, fig. 4) are very pale green, elongate, and very slightly convex. As development proceeds the colour darkens considerably. The insects usually become fixed on a twig with the anterior end downwards towards the limbs, and the conspicuous eye spots are therefore seen at the lower end of the specimens on the plant. The adult female (Plate 127, fig. 2) appears almost dark green to the naked eye, but with the aid of a lens it can be seen that the ground colour is light and that the dark colouration is confined to a series of spots. These spots are most numerous in the median area, and thus the colour becomes lighter as the margins are approached. The adult female is naked, elongate, and convex, and the anal cleft is well defined. The eggs are deposited in a snow white ovisac (Plate 127, fig. 1) composed of closely compacted cottony material. As the ovisac is built up the posterior of the insect is gradually raised, and finally the body of the insect, which dries out and becomes lighter in colour, is seen as a scale-like formation resting on the anterior end of the ovisac, partly covered with the white cottony secretion, and with the posterior end so raised that the whole is almost perpendicular to the surface of the leaf.

The male of this species has not been found in Queensland, and Green in his original description of the insect mentions that the male was not seen by him.

The length of the female is about three-sixteenths of an inch prior to the formation of the ovisac.

Distribution and Habits.

From the available literature it appears that *Pulvinaria cellulosa* has been found in Ceylon and Queensland only, and it seems probable that it was introduced to this State. Citrus is the only host plant of the insect known. In Queensland the species appears to be confined to the southern districts, and reaches its maximum numbers on the Blackall Range and the surrounding coastal country. Dry seasons appear to favour the development of the pest, but it is seldom found in the drier regions, and it would appear that high temperatures are a limiting factor in its distribution. It is seldom that an entire tree is infested by Pulvinaria, and even when very large populations are present they are confined as a rule to a few branches of a tree. The young scales almost without exception choose a twig when settling down, and from that time onward usually remain fixed until mature. Occasionally, however, an immature individual will suddenly commence to wander about the plant, and less often practically the whole of a colony in one position will move away to another part. The normal procedure, however, is to remain fixed, and these chance movements of positions are brought about mostly by unsuitable food supply, or similar unfavourable circumstances. When mature, the females almost invariably leave the twigs and take up a position on a leaf, and it is there that the formation of the ovisac takes place. Though the young are not readily seen, the presence of a large colony is usually betrayed because of this migration of adult females. The snow white ovisac is large and conspicuous, and further,

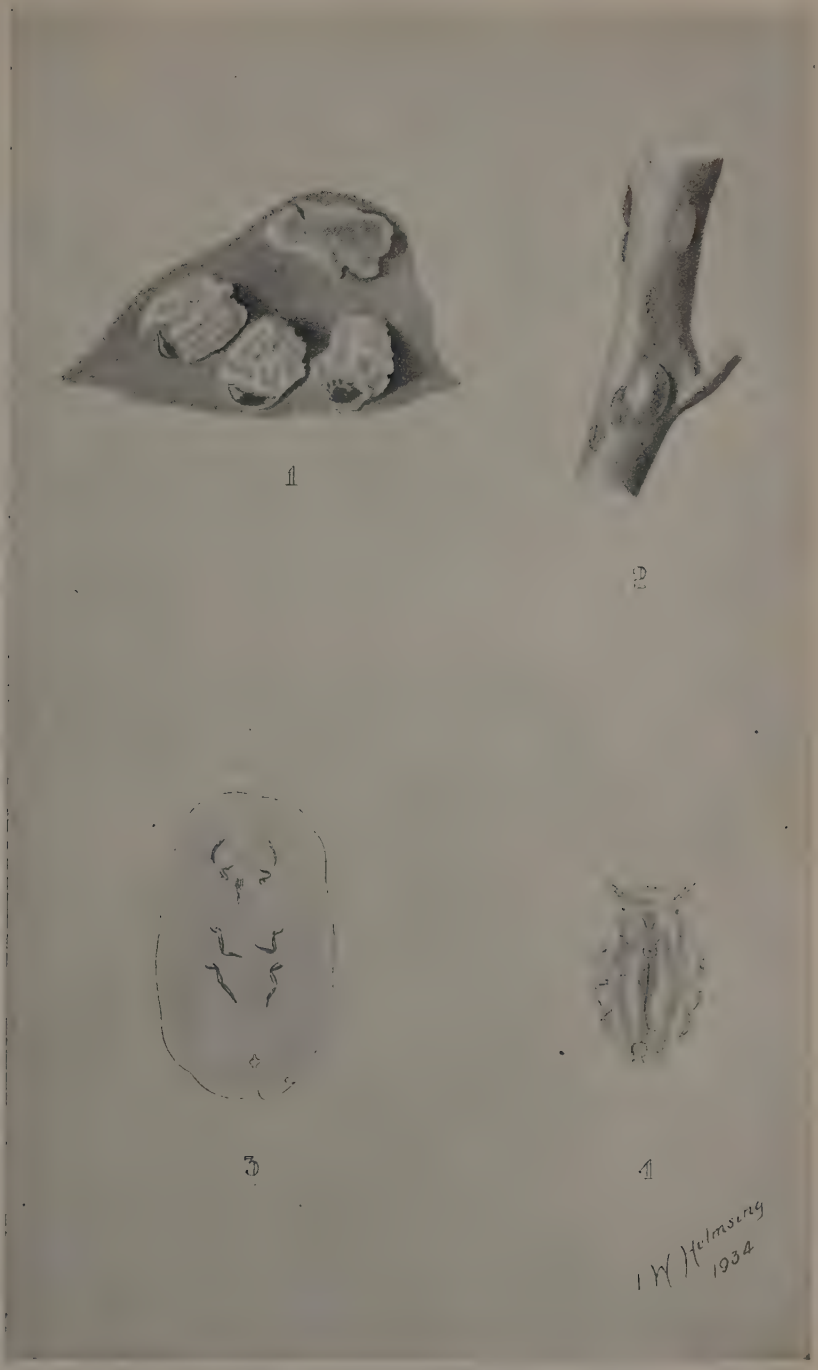

PLATE 127.

Pulvinaria Scale, *Pulvinaria cellulosa*, Green. Fig. 1, Females with ovisacs × 3. Fig. 2, Adult female and second stage nymphs on stem × 3. Fig. 3, Microscope mount of adult female × 8. Fig. 4, Microscope mount of first stage nymph × 60.

though it disintegrates soon after its function of housing the eggs is complete, a little of the cottony material remains adhering to the leaf for weeks or even months after the young have emerged. These remains mark the outline of the old ovisac, and the consequent scar-like marking produced on the leaves is very noticeable if present in any numbers. This is of value to the grower in the matter of combating the pest.

The Pulvinaria scale is not a very injurious insect, and small twigs may carry considerable numbers for several months before any appreciable damage is done. However, on older trees it is the fruit-bearing wood which carries the infestations, and the size of the fruit may be affected. Often the most objectionable feature of an infestation by Pulvinaria is that sooty mould accompanies it. The growth of this fungus may be very considerable, and as it is the bearing wood that is commonly infested, the fungus readily spreads to the fruit.

All varieties of citrus are susceptible to attack, but lemons are usually less heavily infested than neighbouring trees of other varieties. Very young trees usually escape heavy infestation, and it is on four to six year old trees that the largest populations are found. Provided, however, the tree carries a supply of tender twigs, climatic conditions constitute the only factor of importance in determining the incidence of the pest.

Whilst Pulvinaria cannot be considered a very important pest at the present time, it is still much more than a minor one, and its distribution within the districts where it occurs is undoubtedly becoming more general. Though the abnormally dry seasons recently experienced no doubt have had some influence on the position, growers would be unwise to rely too much on the probable return of normal seasons to cope with the increase. The control of the species should therefore not be taken lightly.

Life History.

There are two generations of Pulvinaria each year. Egg production is spread over two months, or a little longer, at the commencement of each generation. The winter is passed in immature stages, and ovisacs are secreted typically in October. A few may even appear late in August, whilst eggs are still to be found well into November. From the secretion of the ovisac to the emergence of young may require up to twenty-three days, but fourteen days is about the average. November, December, and January are spent in immature stages. Towards the end of January, or more typically early in February, reproduction is again commenced. A small proportion of females do not commence ovisac formation until early in March. The young then produced are those which give rise to the succeeding spring generation. Though there is a good deal of unevenness of the times of egg production by different females, this is of little moment, for the rate of development is so slow that overlapping of generations is only manifest for a few weeks, and in no way interferes with effective artificial control.

[TO BE CONTINUED.]

Tobacco Soils of Queensland.

By W. J. Cartmill, B.Sc., Analyst.*

ALTHOUGH the tobacco districts of this State are distributed over a wide area the soils, in general, show a close similarity in type. This is explained by the fact that the demand at present is for tobacco possessing specific qualities, which experience has shown can be raised only on soils of a certain type.

The tobacco plant readily adapts itself to a wide range of climatic conditions; it can be grown on almost all types of soil, and it has a comparatively short season of growth. The crop could therefore be grown in any part of this State, excepting perhaps those areas where extremely dry conditions prevail. But while it can be so universally grown the quality and aroma of the leaf are greatly influenced by soil and climatic conditions. Obviously, then, the crop can be grown profitably only in certain districts which produce a leaf having certain specific qualities which render it acceptable to the manufacturers.

The industry has become specialised to such an extent that the demand is for leaf of a regular and uniform quality that can be adapted to certain specific purposes. It is not worth while growing a tobacco of a nondescript type, for this is both unprofitable to the grower and detrimental to the industry. The tobacco-grower therefore should understand what quality leaf is in demand, and the soil and climatic conditions which are required to produce this leaf.

So far as the soil is concerned, under given climatic conditions the type of tobacco produced will depend on the character of the soil, both as regards its physical and chemical nature, especially the former.

The physical composition largely determines the texture, which is an important property of all soils. The texture is an indication of the coarseness of the grains and is determined by a mechanical analysis of the soil, which consists in separating the soil particles according to their sizes into grades which are distinguished as sand, silt, and clay, and determining the quantities of each.

In order to produce a good quality tobacco leaf the plant must have a fairly rapid and uninterrupted growth. Several factors influence this, particularly climatic conditions and soil fertility; but the influence of soil texture is also great. The soil should be loose and friable so that moisture can permeate through readily, and not at any time tend to conditions of saturation.

There is evidence which seems to establish the fact that a well cultivated loose soil lessens the incidence of fungus diseases. As a rule the lighter the texture—that is, the less clay it contains—the thinner is the texture of the tobacco leaf and the more elastic, pliable, and better the quality of the leaf produced. In the case of tobacco, probably more so than any other crop, the texture and physical properties of the soil influence the physiology of the plant to such an extent as to determine and control the distribution of the distinct types of tobacco.

* In a broadcast address from Radio Station 4QG.

Heavy fertile soils will not produce fine tobacco of any variety. Soils containing a large proportion of clay, or which for other reasons are very retentive of moisture, tend to produce large heavy plants which cure a dark colour. On the other hand, a light sandy soil produces plants with thinner leaves which by proper treatment can be cured to a bright yellow or light mahogany colour.

Cigarette and Pipe Leaf.

The type of tobacco produced in Queensland is confined almost entirely to that suitable for cigarette and pipe mixtures. These demand a thin, elastic, oily leaf of bright colour. The general type of soil found suitable for the purpose is an infertile sandy soil or sandy loam. On account of their infertility these soils, as a rule, are not well adapted to the production of most of the staple agricultural crops.

Tobacco has been grown in various parts of Queensland for upwards of sixty years, but it is only during recent years that the industry has taken a prominent place in Queensland agriculture. Hitherto a tobacco of a nondescript type had been produced, having been grown without much regard to the type of soil or climatic conditions, and for this product there was only a limited market.

Since tobacco is a crop that is grown mostly in tropical and semi-tropical climates, and on soils which are fairly infertile, one would expect to find in Queensland some areas suitable for the production of a desirable quality of bright tobacco. In 1927 and 1928 experiments were inaugurated by the Agricultural Department in collaboration with the Australian Tobacco Investigation to discover if such areas existed. Exploratory plots were laid out in various parts of a large area of country in North Queensland, extending from Mareeba down to Bowen and inland for a distance of about 200 miles. Several types of soil were selected as being likely to prove suitable for the crop. The results of these experiments were very encouraging, and further trials were laid out in 1928 and 1929 with equally good results.

Thus it was established that certain areas in the North had potentialities as being centres of a new and important industry. Since then other areas in the coastal semi-tropical parts of the State, where the soils bear a similarity to those in the North, have given promise of becoming important producing areas.

In North Queensland, the largest district is Mareeba in the Cairns hinterland. This district comprises a large tract of country extending from Mareeba proper westwards to Dimbulah, and is a number of square miles in extent. Further north the industry is being developed in the vicinity of Leura. Other areas in the North are Hervey's Range and Woodstock (near Townsville), Charters Towers, and Bowen.

The districts in Central Queensland comprise Sarina and Koumala (south of Mackay), Miriam Vale, and Bundaberg. A little tobacco is grown in the neighbourhood of Rockhampton.

In Southern Queensland the principal areas are Park Ridge (near Brisbane), Beerburrum, Inglewood, and Texas.

Mareeba.

The Mareeba area in the North is the most extensive in the State and embraces a large area of poor sandy hitherto undeveloped country. The topography is made up mostly of broad, gently sloping ridges, hilly and rocky in places. The country is drained by the Barron River and by several creeks which flow into the Barron. The natural vegetation is fairly dense but not heavy, consisting of stunted gums, bloodwood, box, ironbark, and ironwood; the grasses are mostly kangaroo, spear, and blady grass. The rainfall is moderate, most of which falls in the summer months. Though there are several types of soil in the district, four are distinct, the others being variations of these. In order of importance these types are—

(1) A grey sandy soil with a light-yellow sandy subsoil.

(2) A brown sandy soil.

(3) A red sandy to sandy loam.

(4) A white sand.

The soils are derived mostly from acid volcanic rocks such as granite and gneiss, while some of the red soils owe their origin to ferruginous metamorphic rocks. These red soils are finer grained than those derived from the granitic rocks and contain a higher percentage of silt and clay. The soils derived from granite and allied rocks are light in colour, fairly coarse grained, and infertile. The top soil has a depth of 8 to 12 inches, sometimes deeper, and merges into a sandy subsoil usually yellowish, though sometimes light grey in colour.

The mechanical analyses of these soils reveal upwards of 90 per cent. of sand with only about 3 per cent. silt and 2 per cent. clay. They are classified therefore as sands. In comparison with typical soils of the more important tobacco districts of the United States of America, these Mareeba soils are lighter. Analyses of North Carolina soils, for example, indicate that they contain from 70 to 80 per cent. of sand with 20 to 30 per cent. of silt and clay and are classified as sandy loams. In other words, they have more body. A sandy soil, particularly one of coarse texture, that carries only a small amount of silt and clay is not a very desirable type for several reasons. It is usually very infertile, has a poor water-holding capacity, and on account of its porosity water-soluble fertilizers added to it are readily leached out and lost during periods of wet weather. Such soils, too, are deficient in humus, which is an important soil constituent, influencing in a large degree the growth of the plant and the quality of the leaf.

The mechanical analyses of the subsoils closely follow those of the surface soils, showing a high percentage of sand, mostly of the coarse fraction, but slightly higher percentage of silt and clay, though these two are still relatively low.

There are in Mareeba areas of grey sandy soils whose physical composition closely approximates that of the American soils mentioned. Their silt and clay fractions together make up about 20 per cent. of their composition. They are more retentive of moisture and soluble plantfoods and produce a good yield of high quality tobacco.

The red soils owe their colour to the high percentage of iron oxide they contain. There are two types of red soil in Mareeba—a sandy infertile type formed from ferruginous metamorphic rocks; and a finer

grained, heavier, more fertile type formed from intermediate volcanic rocks such as andesites and diorites. This latter type is a sandy loam containing fair percentages of silt and clay, and its fertility permits of a crop being grown with the application of only a small quantity of fertilizer.

The white sandy soils are invariably coarse and infertile. They have no body and very poor water-holding capacity. Though these soils produce a bright leaf the yield usually is low for the large quantity of fertilizer that must be added to them; the leaf is thin and "papery," and consequently the return is not very profitable. They are formed *in situ* in elevated positions and are distinct from the light-coloured soils, usually small in extent, that occur near the bottom of ridges where there is a seepage or a poor drainage which has brought about the leaching-out of the organic matter.

The chemical analyses of most of the soils of the Mareeba district reveal that they are infertile and lacking in all the principal plantfoods and humus. Such, of course, is a feature of practically all bright tobacco soils, in which the fertility or amount of available plantfood must be limited and supplied in proportions that will give rise to a leaf possessing the desired qualities.

Dimbulah.

Much attention has been focussed on Dimbulah over the last few years on account of the large percentage of good quality leaf which has been produced there. This district, about 30 miles west of Mareeba, is mostly undulating country of sandy ridges. The country is drained by the Walsh River and several creeks. There are four main types of soil, all of which are tried for tobacco cultivation—

(1) A grey sandy soil.

(2) A light-brown to light-red sandy soil.

(3) A white sand.

(4) An alluvial sandy loam.

The soils are derived principally from granitic rocks. The grey sand is similar in mechanical analysis to the same type of the Mareeba district, being fairly coarse in texture with little silt and clay. It is usually underlain by a yellowish coarse sandy subsoil. In one area at Dimbulah is a grey sandy soil of lighter colour and texture, consisting mostly of fine sand with about 5 per cent. of clay. This area grows a good quality leaf but is not well elevated and mostly requires artificial drainage.

The light-brown sandy soils have a wide range. They are nearly always found on elevated sites that are well drained, and the type is much sought after. They are soils with a fair body, too, having up to 10 per cent. of clay and silt and the sand fraction, mostly fine. They are fairly retentive of moisture, and the humus content, though not high, is greater than the other types.

The white sands are not cultivated extensively. They are very infertile, coarse in texture, and practically devoid of humus.

The alluvial sandy loams occur on the flood plains of the Walsh River. They are the most fertile soils in the district, and consist largely of fine sand and silt. The humus content is fair. The leaf produced on these soils is mostly bright mahogany, with good body and texture.

The chemical analyses of the Dimbulah soils are, in general, similar to the corresponding types of the Mareeba district. They are deficient in all the principal plantfoods and in humus.

Hervey's Range.

In the Hervey's Range district, near Townsville, the soils consist largely of coarse sand. This, in itself, would be a defect were it not ameliorated by fairly high percentages of silt and clay, which in this instance is the case, giving the soil binding properties and adding to its water-retaining facilities. The country is elevated and surrounded by rocky ridges.

Woodstock.

At Woodstock, also near Townsville, are patches of sandy soil being used for tobacco cultivation. They are mostly grey medium-textured sands with fair humus content.

Charters Towers.

At Charters Towers the soil is of medium texture with low percentages of the fine fractions.

Bowen.

At Bowen tobacco is grown on fairly fertile alluvial soils at the delta of the Don River. On virgin soils the crop is grown without fertilizer, and some heavy yields have been recorded. The humus and nitrogen contents of these soils are fairly good. They are dark-grey and brown in colour. The mechanical analyses show high percentages of fine sand, but a low amount of the other five fractions. Soils from other parts of the Bowen district are mostly coarse sands.

Sarina.

The soils cultivated in the Sarina district, 20 miles south of Mackay, are grey and light-brown sands. Around Mount Chelona are brown and greyish soils on poor, coarse, sandy, and gravelly ridges. Similar in nature to these are the Blue Mountain soils near the coast.

Beerburrum.

Recently a large area of country has been opened at Beerburrum for extensive tobacco cultivation. Previously small crops grown in this area had produced leaf of high quality, indicating that conditions there appeared to be eminently suitable for the cultivation of bright tobacco. The topography of the country is made up of broad, gently sloping ridges of sandy soil draining off into swamps and creeks. The soils are derived from sandstones of marine origin. The most prominent type is a grey sand with a yellow sandy subsoil, the top soil having a depth of about 8 inches. It is a fine to a medium-textured sand with small amounts of silt and clay, though these fractions are, on the average, higher than in most of our bright tobacco soils. The humus content, on an average, is also higher, in this instance approaching the "fair" grade for sandy soils, and it is to this property of the soil that the high quality manifested by much of the Beerburrum leaf can probably be ascribed.

One other prominent type of soil in this district is a red sand and sandy loam. It occurs mostly in the Glass House Mountains area on elevated sites such as the crest of ridges. It is underlain either by a red sandy clay or clayey subsoil.

Park Ridge.

The soils of the Park Ridge area, about 20 miles from Brisbane, are similar in many respects to the Beerburrum soils. The main type is a grey sand underlain by a yellow sandy subsoil. The ridges are broad and elevated, draining off mostly into ti-tree swamps. The virgin soils have a fair humus and nitrogen content.

Texas.

In the Texas district, which is situated on the Southern border of the State along the Dumaresq River, tobacco has been cultivated for a number of years. The crop is grown under irrigation on flat country bordering the banks of the river. The type of soil most extensively cultivated is an alluvial loam and, being fairly fertile, a high yield is obtained without the aid of artificial fertilizer. This is not generally considered the best type of soil for growing tobacco, but it represents the character of the soil on which most of the tobacco is grown in this part of the State. Latterly, development has been down the river and about Yelarbon, where the soil is of a lighter type—a sandy loam—on which bright and fairly good quality leaf has been produced. Fertilizers are being used to advantage on some of these areas.

At Inglewood the soils are similar to those of Texas.

Summary.

Summing up, the soils of all our bright tobacco areas are, in general, infertile sands derived principally from granites and sandstones. They are deficient in all the mineral plantfoods and in humus. Tobacco is an exhaustive crop and requires fairly large quantities of the principal plantfoods. With an insufficient supply of any one, the plant readily responds to the deficiency with deleterious effects on the quality of the leaf. The plantfoods can be readily supplied in the form of artificial fertilizers, but the humus is a more difficult problem. The greatest defect of most of our tobacco soils is their deficiency of humus. What little the virgin soil contains is depleted considerably after a few crops have been removed. Green crops must then be grown and ploughed under to replenish the supply, and the practice repeated, if possible, after the removal of each crop.

Most of the tobacco soils so far analysed are slightly acid. This state of slight acidity is considered by authorities to be the optimum for the production of good quality leaf. Experiences in Queensland, however, are not exhaustive enough to enable us to draw conclusions as to the influence of soil acidity on the quality of the leaf. Each of our principal districts has produced some good leaf, which often has certain specific qualities, particularly with regard to aroma, which distinguish it. Each district has possibilities, but in order to get the best results a careful study of the soil and its treatment must be made. In order that the patient work of collecting data might not be hampered co-operative action between farmers and the Department is essential, for there is much to be learned before we can hope to produce consistently good quality leaf.

Problems of Wheat Production.

By R. E. SOUTTER, Wheat Breeder, and Manager, State Farm, Bungeworgorai.

THESE notes, although presented under the title of "Problems of Wheat Production," deal with soil erosion, a subject which concerns not only the wheatgrower, but every individual who directly or indirectly depends upon the products of the soil for his or her livelihood. So calamitous have the effects of soil erosion been in the United States of America, that it is calculated thirty million acres of first-class agricultural land have been rendered worthless, and an additional sixty to seventy million acres have been so seriously affected as to be nearly worthless. The same rapid deterioration due to the same agency is going on in most countries of the world, but more rapidly in those countries where the rainfall is at times torrential. These forces of destruction are at work in our own State, and there are many areas in the coastal belt which, after having been cleared of timber, in a comparatively short period have had their producing capacity so reduced by this cause as to be only fit for grazing, and even for this purpose their value is depreciating yearly.

Fortunately, it is possible to prevent this calamity, which it undoubtedly is, and still utilise the land for ordinary agricultural purposes, and that is by making contour drains. This system of preventing erosion has been practised in the United States of America for some considerable period with remarkable results. Coming nearer home, the New South Wales Department of Agriculture was quick to recognise its potentialities and gave practical demonstrations in several sections of that State, with the result that many private individuals have practised it, and so successfully in most instances that the area being dealt with is increasing each year.

During a recent visit to the mother State, I had the opportunity of inspecting areas which had been dealt with in this way at the Wagga and Cowra Experiment Farms. It was at Cowra, I understand, where this system was first tried, and in one location was so successful as to render a dam useless by causing the water to percolate instead of running off.

The following has been taken from an article on the subject supplied to me by the compiler, Mr. Kelly, Manager of Cowra Experiment Farm, New South Wales:—

Surface draining as a means of preventing erosion by controlling the water flow in the paddocks is by no means new, but owing to wrong methods the work done in many instances has not only proved fruitless, but has rather accentuated the injury it was attempting to control. In some cases this has been occasioned by the drains not being large enough, and in other cases through relying on the judgment of the eye to run out a drain. This latter method is the surest way to court failure. The old fallacy that ploughing in channels will arrest erosion has long since been exploded. Results can only follow a determined attack on the cause of the trouble. If paddocks have been eroded badly, the matter of restoration is both lengthy and costly.

Experience in America and at Cowra Experiment Farm has shown that the only successful and practical method of dealing with soil erosion is by terrace farming or the adoption of broad-base contour drains. By the latter is meant a banking of earth to arrest the flow of surplus water with a wide sloping drain on the upper side of the bank to collect the water and convey it to a suitable outlet. The gradual slope permits of the maximum absorption and reduces to a minimum, erosion of the drain itself.

The banks vary from 1 to 2 feet in height, 10 feet in width, and with the open drain of the same width. The banks should be of such a height and nature as to admit of the passage of teams across them so that there will not be any uncropped land, or idle ground for weed propagation.

Select a road, permanent pasture paddock or natural watercourse as the outlet for the drain if possible. If such are not available, a wide drain will of necessity have to be made, and the laying-down of this with lucerne or some other permanent crop will prevent erosion here. As the desire is to carry off the surplus water as slowly as possible, there are three points of paramount importance.

(1) That the correct *grade* be obtained in constructing the drain.
(2) That the drain and bank be of ample proportions.
(3) That the distance between the contour drains be kept in direct accordance with the area and slope of the land to be drained.

Dealing with the first point—*Grade*—experience has shown that a fall of 1 inch in 16 feet 8 inches (or 1 in 200) will give the requisite grade to carry water slowly and without damage to the drain, all things being equal. With the home-made level to be described later, the correct fall is automatically obtained.

With regard to the second point—*Capacity of drain* and dimensions of bank—this will be governed by—

(*a*) Area which the drain has to cater for.
(*b*) Slope of the area.
(*c*) Type of soil.
(*d*) Length of drain.

The further the drains are apart the greater the dimensions must be of the contour drains. The greater the slope the greater will be the velocity of the surface water over the terrace and in the drain, therefore the latter must be sufficiently large to hold and convey the water received.

The type of soil will have an influence; sandy soils and light loams absorb water much more rapidly than clay soils, therefore the latter will give a greater run-off, which necessitates the consideration of this aspect when laying out contour drains.

The longer the drain the greater the accumulation of water, and consequently increased capacity should be allowed for in the construction of it. Where possible the drains should not be long, for the shorter they are the less likelihood of the water breaking over them. As regards the point of ratio of surface to be drained and size of drain, the size of drain and height of bank have certain limitations due to several factors such as machinery available for construction and the working of cultural implements over the banks.

We now come to the third point—*Distance between the contour drains*—which will be decided by the slope of the land. This can be gauged by using a straight edge, 16 feet 8 inches in length. Place one end on the ground on the uphill side, and placing a spirit-level on the centre, raise the lower end of the straight edge until it shows level. Six times the distance from the ground to the raised end of the straight edge gives the fall in 100 feet. Generally a vertical distance of 9 feet between drains will prove satisfactory with minor alterations to suit peculiar conditions which exert a controlling influence. (This vertical distance would, in all probability, be far too great for Queensland.)

With a slope of up to 6 per cent. drains three chains apart have proved satisfactory, but with a greater slope they require to be correspondingly closer. Consideration must be given to any accumulation of water from grass paddocks or other sources on adjacent higher land.

Taking Levels.

For all practical purposes, accurate and satisfactory results will follow the use of the home-made level, which is made as follows:—

Of Oregon pine, 5 or 6 by 1, obtain one 8-foot length for upper stay, one 11-foot length for centre stay, on which rests the spirit-level, and two pieces 7 feet 6 inches long for the legs. Mark out on a floor or other level surface an isosceles triangle having a base 16 feet 8 inches long with sides 11 feet. Lay legs along side, keeping mark on the inside and allowing sufficient projection at base to cut on bevel. Next lay 8-foot piece across narrow end, allowing sufficient overhang to enable both legs and top stay to be cut flush, and nail securely. Place the other stay across, allowing sufficient projection at either end to cut flush with edges of legs, and nail one end. Stand upright and place spirit-level on centre stay and when it shows level make secure. If any doubt exists as to the floor or surface used being level, the following method can be adopted:—

Drive two pegs 16 feet 8 inches apart in the water at the edge of a dam so that the top of each peg is just level with the surface, then test. When proved correct, at each intersection bolt with two bolts. When these have been tightened up, test again, and if found level, cut an inch off one leg, and mark it upper. A frame for holding the spirit-level in position on centre stay whilst moving about will be found to save a good deal of inconvenience.

Before taking any levels make a detailed inspection of the area to be dealt with, which should afford some idea as to the volume of water to be catered for. The next thing is to decide as to the best place for the outlet. At times it is necessary to have central and intermediate channels for the final disposal of the water accumulated by the drain.

Drain-making should commence at the highest end of the paddock, for if started at the lower end and rain is experienced before the work is completed the drains made would not be capable of dealing with the run-off.

With the home-made level, pegs, and other equipment a start is made on the top drain from where it has been decided to have its exit. Place the long leg of the frame or level at this point and use as a pivot for moving the shorter leg backwards and forwards until the spirit-level shows level, then drive a peg in where the short leg rests; next move

the frame along until the long or lower leg rests alongside this peg and use as a pivot as before, and when level shows level insert another peg, and repeat until the other side of the paddock has been reached.

In view of the fact that one leg of the frame is 1 inch shorter than the other, the result will be a fall of 6 inches in 100 feet, or a half per cent.

As the ground varies in slope the drains will be found to wind a good deal and a number of sharp small bends will also be observed. These latter are due to minor depressions or rises and can be ignored when constructing.

The marked position of the drain having been defined, the construction can now be commenced, for which the following implements can be used, viz.:—

(1) Disc plough.
(2) Disc plough in conjunction with grader or delver.
(3) Mouldboard plough in conjunction with grader or delver.
(4) Grader or delver.

Of these the disc multiple-furrow plough is probably the most economical and as efficient as any to use. If available, a single furrow can be used to strike out along the line of pegs, throwing the sod downhill, which will give a good line for the multiple-furrow disc to follow as well as leave the pegs uncovered. With the disc plough the first furrows should be thrown uphill, allowing the front wheel to run in the furrow left by the single plough and backing this up from the upper side and so form a ridge in the centre, and continue in this way for three or four rounds according to whether the plough is a five or a four furrow. Strike out again at centre and continue for three or four rounds; then again strike out at centre and back up again for three or four rounds, according to number of discs. This procedure should normally provide a bank of sufficient height and a drain on the upper side capable of carrying off the water.

The running of an additional trip along the top side of the drain with the rear furrow very shallow will give the top side a gentle slope and also produce a certain amount of loose earth which can be worked over the bottom of the drain.

To level and finish off a spring-tooth cultivator should be run along the drain and the ploughing on either side of the bank. This operation not only consolidates the soil, but the tracks lead the water along the drain, and in addition a certain amount of good soil is spread along it and so ensures a better crop growth.

If a paddock has been scoured prior to putting in the drains, it will be found that in some places the banks will be too low and so will have to be raised and strengthened in order to prevent water breaking over, and to do this an earth scoop will be found most suitable. Stubble land is in the best condition for draining, as the passing to and fro of the teams and implements, &c., have consolidated and levelled the surface to such an extent as to render the surveying for the drain a very simple matter; nevertheless, well-settled fallow can be dealt with satisfactorily.

The first ploughing after draining should be along the line of contour to avoid crossing the drains, but after the banks have become consolidated it can be done in any direction.

Finally, never let the efficiency of the drains or banks become impaired or very serious damage may be the result.

Wheatgrowing in the Maranoa.

By R. E. SOUTTER, Wheat Breeder, and Manager, State Farm, Bungeworgorai.

QUEENSLAND, although not looked upon as a wheat-growing State, produces sufficient to meet her own requirements, and has the second highest average yield per acre in the Commonwealth, 15·18 bushels—being beaten by Tasmania with 21·78 bushels. With the adoption of a cultural system which has for its objective the conservation of moisture the discrepancy between these two averages can be reduced, seeing that varieties with increased rust resistance and ability to produce grain under adverse conditions have been evolved and are being improved upon.

Even in the more favoured districts of the Darling Downs, where the meteorological conditions are such that fair to good crops are obtained nearly every season, the practice of the short fallow would tend to raise the average, whereas in the Maranoa, where the rainfall is less, the adoption of the long fallow in conjunction with the short fallow is considered essential to success. That success can be looked for, will be gathered from the fact that in 1918 a 30-acre paddock worked on the long fallow sown to "Warren" wheat in May and harvested in October gave a return of slightly over 24 bushels to the acre, on a rainfall during the growing period of 1·96 inches. The yield obtained on the short fallowed section was 17 bushels.

During the 1931 season, the rainfall from May until the crops were ready for harvesting (October), was 3·71 inches; the yield from a small long-fallowed section was 24·4 bushels per acre, whereas the short fallowed portion gave a return of 16·5 bushels.

The average yield obtained on the short fallow over a period of seventeen years is 17·1 bushels, the average for the district over the same period being in the vicinity of 8 bushels.

That the yields just previously mentioned were the result, not of the rain which fell during the growing period, but of that which had been previously conserved in the soil, may be gathered from the fact that, according to recognised authorities, to produce, say, 15 bushels of wheat 4½ inches of water are required to pass through the crop, and for every extra 10 bushels 3 inches more are necessary. To produce the crop of 24 bushels in 1918 nearly 7¾ inches of water would be required. So, even supposing that all the rainfall (1·96 inches) was available to the crop (which it was not) it was necessary for the moisture content of the soil to be sufficiently high to permit of approximately 5 inches being furnished to the plants.

A glance at any rainfall chart will serve to show that in Queensland the season of the greatest precipitation occurs during the summer months when the weed growth is exceptional and evaporation greatest, and it follows that this must most assuredly be the season of greatest cultural activity so that the moisture may be trapped and conserved for the future crop's requirements.

What operation to carry out, and when, cannot be stated definitely, as experiments carried out to determine same only emphasise the fact that no hard-and-fast rules can be laid down, there being so many controlling factors, and it remains with the individual who is aware of the peculiarities of his case, and who should be armed with the knowledge which will enable him to surmount them.

Long and Short Fallows.

The difference between a long and short fallow is that in the former case the land is cropped every second year with wheat, and in the interim is worked so that the maximum amount of water possible from the rain experienced is retained in the soil; whereas the short fallow is cropped again the following year, cultural operations having immediately followed harvesting operations and continued until sowing time. With the adoption of the long and short fallow on a wheat farm, it is necessary to subdivide the area it is intended to crop into three sections; two of which will be sown the first year (short fallow), the other kept worked and sown as the long fallow quota in the following season. In the second year one of the two sown the previous year will again be sown (short fallow), and the other reserved for sowing next season (long fallow).

From the foregoing it will be seen that two-thirds of the area is cropped every year, half of which is on a long and half on a short fallow after the first year. At the Roma State Farm the *modus operandi* in connection with the short fallow, likewise the initial stages of the long fallow, is to commence cultural operations as soon as possible after the grain has been harvested.

If the soil is too dry for ploughing, the disc cultivator is run over it, with the result that the stubble is broken down (we seldom get a burn), weeds are checked and the surface is broken, which lets the rain in when it comes. To all appearances, sometimes very little good is being accomplished, nevertheless it is surprising how much longer ground treated in this way remains in good ploughing condition than if it were neglected.

Ploughing.

As soon as the land is in a fit condition to carry a team without injury after rain has fallen, ploughing should be gone on with. This does not necessarily apply to the land already disced, for, as stated before, this land will remain in good ploughing condition for some time longer than unploughed land.

Now good cultural methods in connection with wheat production at one time were considered to necessitate deep ploughing, but this has been shown to be a fallacy. Not only is it not essential, but it may at times be detrimental for, in our experience, when the work has been done late in the season, or when the conditions following have been unfavourable to consolidation, it has proved injurious and in seasons of very limited rainfall has resulted in failure.

The depth looked upon as giving the best results on most classes of soil is in the vicinity of 5 inches, which depth when worked up provides a good mulch and seed bed, and at the same time forms a fairly large reservoir for water should heavy rains be experienced, an essential on soils of slow percolocity.

After the initial operation of ploughing has been completed, the inverted soil is permitted to lie in the rough state for five or six weeks, or until sufficient rain falls to mellow it, so that heavy harrows will bring it to the desired tilth. All subsequent work must be in the direction of preventing the formation of a hard crust and weeds from growing, both of which tend to nullify the results of operations already carried out for the retention of moisture. This means that as soon after rain as possible it is imperative that the soil mulch, which will have been rendered ineffective, be restored.

Restoring Surface Mulch.

The implement to use for this purpose will depend on those available, but as a rule harrows, spring tooth, and a one-way cultivator are found on most farms, one of which will be capable of dealing effectively with any condition of the soil towards the restoration of the mulch.

Should the soil be of a good mechanical condition and not weedy the ordinary harrows will prove effective; whereas if it is weedy and the surface has set the one-way cultivator will have to be brought into use. If the ground is clean but set too firmly to respond to the harrows, the tooth cultivator is the best, for the reason that it does not reduce the mulch to the same state of fineness as the harrow. Whichever implement is used, the operation of restoring the soil mulch should not be attempted before the soil is in a condition to respond fully to the treatment, that is, when it is in its most friable state.

Depth of Mulch.

As a result of observations made on most classes of soils in many parts of Australia, it is considered by those in a position to know that from 2½ to 3 inches is the most economical depth. Anything shallower would not be effective, and a greater depth more costly in proportion to increase in effectiveness.

Depth of Sowing.

From 2 to 2½ inches is considered to be the most suitable depth to sow, although deeper sowing is sometimes practised on light soils to ensure germination; but even at 2½ inches on clayey loams, similar to those at the Roma State Farm, many plants would fail to reach the surface should heavy rain fall immediately after seeding, more particularly if other than graded seed had been sown.

Rate of Sowing.

This is governed by the variety and season of sowing, but as a general rule 30 to 35 lb. to the acre will suffice for early and mid-season (April to third week in May), whereas 40 to 50 lb. to the acre will be necessary on areas sown later.

Direction of Sowing.

All cultural operations carried out in the latter part of the season should be at right angles to that which it is intended to sow to ensure that all seed is well covered and germinates evenly. Otherwise where the drill runs in the same direction as a plough finish, a portion of the grain is just covered or left lying on the surface, with the result that it does not germinate until rain occurs, which, delayed for any length of time, causes unequal ripening, thereby hampering harvesting operations or affecting quality of grain.

Varieties.

On the sowing of suitable varieties depends the ultimate success of all a farmer's cultural operations.

Of the new wheats evolved and which have come into general cultivation, the bulk are very much earlier than their predecessors of some years ago, due to the fact that their earliness very often enables them to escape rust; and at other times in seasons of limited rainfall to produce grain under conditions practically fatal to slow-growing kinds.

This earliness, in conjunction with indiscriminate sowing, is no doubt a contributing factor to the extra damage done when late frosts are experienced. In an endeavour to mitigate this to some extent, the season for sowing those varieties grown most extensively in the Maranoa will be given.

Variety.	When to Sow for Grain.	Rate in lb. per acre for Graded Seed.
Amby .. Cleveland	End of April to end of May (second week)	30 lb. per acre
Currawa Warchief Warren	Good varieties to sow on locations subject to late frosts	30 lb. per acre
Bunge .. Cedric ..	May and June	May (first and second week), 30 lb.
Clarendon Gluyas .. Nabawa	May and June	May (third and fourth week), 40 lb.
Novo .. Reward Three Seas	May and June	June, 50 lb.
Flora .. Florence Watchman	From May (second week) ..	May, 40 lb. June, 50 lb.

Reward, which is a small, shotty red-grained wheat, had better be sown at a rate of 5 lb. to the acre less than the others.

The foregoing has not been designed for the low-lying lands adjacent to creeks, which are susceptible to heavy and late frosts, so it will be necessary for the individual farmer to make allowances. From the varieties he has previously grown, he will probably decide that those in No. 1 can be sown early in May, No. 2 after the second week, and No. 3 in June.

Harrowing the Crop.

This should be carried out after rain, across the drills, when the plants have a firm hold in the soil and as soon as the soil will carry a team satisfactory.

This operation, which results in a loosening of the surface, preventing evaporation and leaving it in the best condition for the reception of more, also retards the growths of weed seedlings, induces deep rooting and possibly increased tillage.

Deficiency of Winter Feeding on Natural Pastures.

By J. L. HODGE, Instructor in Sheep and Wool.*

IT would appear from current press reports and letters received from graziers by the Department of Agriculture and Stock that at last stockmasters are waking up to the fact that natural grasses in winter time are, on a great many properties, insufficient to maintain health in sheep, and especially lambing ewes and weaners. From as far out as Winton and Longreach information has reached this office of a feed deficiency in the winter months even on the Mitchell grass plains when apparently grass is plentiful. This, I think, may be attributed to constant stocking with sheep over a comparatively great number of years and insufficient care on the part of those in charge of properties in the matter of systematic spelling of paddocks with the idea of allowing the indigenous grasses to seed.

A few years ago, comparatively, it was difficult to convince some graziers that their sheep were suffering from malnutrition during the winter months. To the inexperienced eye there was plenty of feed, and it was not recognised that the better and softer indigenous grasses had, to some extent, disappeared. The idea of semi-starvation was not generally accepted. It is admitted that the conditions as described apply more to the pastures closer in, where the stocking with sheep has been of longer duration and heavier stocking has been the more common practice.

The question naturally arises as to what should be done to remedy this state of affairs. For the far-west and central districts, it would appear essential that a proportion of the run should be allowed to seed each year. This does not mean that the grazier would entirely lose the benefit of that country. Sheep could be depastured after the grasses have matured and the seed has fallen.

Overstocking should be generally discouraged and every effort made, having due regard for economy, to get the property back into "good heart." If the grazier would realise that, over a period of years, it was to his financial benefit to stock comparatively lightly, we would hear less of the evils of winter grass deficiency. Subdivision of the country would certainly help in the regrassing of the run where the cost of fencing is not prohibitive. The full advantage to be gained from spelling paddocks in rotation is then easily assured. At the present time regrassing is impracticable. It would therefore appear, to a great extent, that the question of better winter pastures is in the hands of the graziers themselves.

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* In a broadcast address from Radio Station 4QG.

The Value of Suitable Licks.

The grazier may help the stock through the trying winter months by supplying a suitable lick. It has been found that the addition of a protein is useful and profitable for the purpose.

I recommend the following:—

	Parts.
Nauru phosphate (finely ground)	40
Salt (butcher's quality)	40
Sulphate of iron	4
Epsom salts	4
Linseed meal, cotton meal, maize meal	12
	100

Here you have phosphoric acid necessary to all animal life, a necessity in salt, a tonic in the iron sulphate, a laxative in the epsom salts, and the protein recommended in the meal. The lick may be given with safety all the year round, if necessary, to dry sheep, but a great proportion of the salt should be taken out of the lick if it is proposed to supply ewes half way through the period of gestation. This is recommended on account of the fact that with the meal added the ewe is likely to take too much salt with ill-results.

Deficient Pastures on the Darling Downs.

On the Darling Downs the overstocking of natural pastures applies to an even greater extent than on far-out areas.

The holdings are very much smaller and have carried sheep for a longer period and, in addition, it must be admitted that the practice of overstocking has been more common, to the detriment of the indigenous grasses.

On the Darling Downs a greater opportunity exists to do something useful in the way of pasture improvement, as apart from ordinary cultivation. The Department of Agriculture and Stock has initiated an experiment there with the idea of trying out, in a practical way, certain grasses and clovers for winter feeding. We feel that something useful will result, and full information will be published in due course.

Winter Crops for Sheep.

Cultivation of small areas on the Darling Downs must come into general practice if sheep, and especially fat lambs, are to be raised profitably. Wheat, barley, and oats are all recommended. They are excellent crops for the winter feeding of sheep, and there is, of course, the prospect of a cereal crop. Lucerne cannot be too highly spoken of. Taken all round, there is no better sheep feed grown, and it is surprising where it does grow.

All farmers grazing sheep are advised to sow Rhodes grass on newly-cleared scrub land. The grass has been proved to do well on this class of country, and is a great feed both for sheep and cattle. The farmer growing wheat is losing some of his legitimate profit if he does not run some sheep. Even if breeding is not practicable, sheep acquired as stores are a necessity in most seasons for the good of the crop itself. Wheat lends itself splendidly to the fattening of old sheep, which would

be a hopeless proposition on natural winter pastures. This fact itself should be a great inducement, if such be needed, to farmers to provide adequately for their sheep in the matter of feed during the winter.

The costs of the Downs lands being what they are make it essential, if a fair return on capital outlay is to be obtained, that the farmer should get more out of his land without impoverishing it than can be yielded from indigenous pastures. Everyone engaged in dairying admits this, and the same applies when running sheep.

Cultivation and Fat Lamb Raising.

The Department of Agriculture and Stock has commenced an experiment in fat lamb raising with the idea of finding out the best crosses for the raising of fat lambs, both for home consumption and export.

In every case where English type rams have been loaned to farmers under the scheme a certain amount of cultivation has been insisted upon, it being recognised that the raising of early maturing fat lambs on natural pastures is not to be recommended. It is believed that the results will go far, not only to demonstrate the crosses wanted, but to prove to farmers on the Downs the economic necessity of winter feeding. All engaged in the fat lamb industry should realise early that the lamb must follow the plough. Another point of material importance is the loss in weight of wool in a poorly-fed sheep, in comparison with one properly nourished. It is safe to say that two adequately fed sheep will yield more to the grower than three half-fed animals.

The question of internal parasites in sheep is of no small importance when proper nutriment is under discussion. A well-fed sheep is far more resistant to this pest, and it is able to stand and responds much more readily to the necessary treatment.

From every point of view it pays the farmer to make the necessary provision for adequately feeding his stock during the winter.

We may regard ourselves as fortunate, in comparison with other countries, in that winter housing of stock is not necessary under our genial climatic conditions.

DROUGHT FEEDING OF SHEEP.

In spite of the fact that it is generally held that a sheep must have bulk to accommodate its large digestive organs, it is interesting to speculate, pointed out the officers supervising a drought-feeding trial with sheep at Hawkesbury Agricultural College in their report, how far the lack of bulk (which consumes in its digestion an amount of energy disproportionately high to the value extracted from it) is responsible for the good results shown by a ration of 12 oz. of maize, and the relatively poor results from rations in which the basic 4 oz. of maize was supplemented by roughages of low fat and high fibre content (oaten hay and mixed oaten and lucerne hay).

The indications are that when sheep are on a maintenance or sub-maintenance ration the conservation of muscular energy (by confinement to a relatively small area) becomes an important point, and is a natural corollary of conservation of digestive energy (by minimising the fibrous content of the ration). Such a procedure would be limited in practice by the possible incidence of worm infestation consequent upon fouling of the ground, but it would be reasonable to expect better results by concentrating sheep in handy 50 or 100-acre paddocks, changing as frequently as possible, than by allowing them the run of large paddocks, even with the extra picking of roughage.

Pig-feeding.

By L. A. DOWNEY, H.D.A., Instructor in Pig Raising.

[PART I.]

The subject of animal nutrition is a very complex one, and while there is a vast amount of data on the subject, and there are many useful scientific publications, Queensland pig raisers are still in need of information in a simple form, telling how scientific findings can be put into practical use on the farm. An endeavour has been made by Mr. Downey in these notes on pig-feeding to give the farmer a little clearer insight to this important subject and to avoid technicalities as far as possible. Research work on nutrition is still progressing, and, consequently, information given now may be altered by future findings.—ED.

THE ability of pigs to make economical gains in weight is determined by their breeding, management, and feeding. Well-bred thrifty pigs that are well cared for and kept in good health will make the best use of the available foods, but at the same time the old saying that "half the breeding is in the feeding" is very true regarding pigs.

The pig is a vigorous feeder, thriving on both animal and vegetable food—in fact, preferring a mixture of both. There are very few foods which he will not relish, provided they are wholesome. Decomposed foods should not be used. The pig has a comparatively small stomach and is not able to consume large quantities of bulky foods as the cow, sheep, and horse are; therefore, while a little roughage is desirable, concentrates should predominate in a pig's ration.

In most circumstances, full feeding, either by hand or self-feeder, is a wise practice and, provided the animal receives a complete and balanced ration and the necessary exercise and is bred to the desirable type, it will produce a desirable carcass at the required weight; but if small-type pigs are being fed to bacon weights, limited feeding must be practised. While the nature and composition of a pig's food affects the proportion of fat and lean in the carcass, the inherent conformation and the environment are also important factors.

Up to the present, pigs have been kept in Australia chiefly to utilise by-products from other industries, more particularly the by-products of the dairying industry, and when such foods are available cheaply they form the basis of pig-feeding rations. While pig raising is dependent on other industries for food supplies, the selection of foods and the preparation of rations will depend almost entirely on the availability of by-products; but when pig raising is undertaken as a special business, then provision of a food supply is a different matter, and the selection of foods to be grown or purchased requires very keen attention.

No one of the foods commonly used for pigs in this country is in itself sufficient to make a satisfactory ration, and to get the best from the basic foods, the farmer should add to them other foods which will improve their capacity to produce large gains in the pigs. These added foods may be either home-grown or purchased, according to the circumstances.

The pig raiser should know what quantity of food his pigs are using to make a pound of pork, and whether the value of that pork is sufficient to pay for the food as well as labour and other charges. When foods have to be purchased, their cost must be considered as well as their feeding value and their suitability when used in combination with other foods.

Maintenance.

Food is usually given to animals with the object of producing growth, work, milk, &c., but before any of these can be produced, the animal body must be maintained,—i.e., the body heat must be kept up, waste tissue must be replaced and the necessary energy for the movement of body muscles must be supplied. Approximately half the food given to a young pig is used for maintenance before any growth can be expected; this explains why the quicker the animal is grown the greater the amount of food saved on maintenance.

The normal body temperature of pigs is between 102 deg. Fahr. and 103 deg. Fahr. This temperature must be maintained. There is a continual production of heat in the body through tissues being oxidised (burned) and there is a continual cooling of the body through evaporation and radiation from its surface. On account of its thick skin and thick layer of fat beneath the skin, the pig does not perspire freely and so must be kept cool by radiation.

The growth of young animals is dependent on a supply of food in excess of a maintenance allowance, and with pigs this is perhaps the most important object in feeding from the practical viewpoint, for, having produced the young pigs, the farmer's object is to grow them rapidly and as economically as possible.

In mature breeding stock food is used not only for maintenance, but for the production of young. After the birth of the young, the sow has to secrete milk to feed them for a couple of months. This means an extra call on her body which must be supplied with the necessary food.

The laying on of fat is nature's way of laying up a reserve of energy and heat in the animal body, and animals at any age, if supplied with sufficient food, will store fat in the body. There is, however, a greater tendency to store fat when the animal is past the early growing stage. The fat is stored in layers between the skin and the muscle in the internal cavities of the body, and intermingled within the muscle fibres. This latter is known as marbling in lean meat.

Some Definitions.

Digestion.—Digestion is the process of changes which foods undergo while they are in the digestive tract of the animal, when they are separated into the portion to be assimilated and the portion to be excreted directly.

Assimilation.—Assimilation is the absorption of the useful portion of the digested food within the body.

Nutrient.—Nutrient is a substance used in the nutrition of animals.

Digestible Nutrient.—Digestible nutrient is that part of a crude nutrient which can be assimilated by the animal.

Ration.—Ration is the quantity of food given to one animal for twenty-four hours, whether it is given in one or several feeds.

Balanced Ration.—Balanced ration is the total quantity of food, containing the various digestible nutrients in the correct proportions, given to an animal in twenty-four hours.

Maintenance Ration.—Maintenance ration is the quantity of food required by an animal for body maintenance only, for twenty-four hours.

With the exception of air, water, and sunlight, all requirements of animals come either directly or indirectly from plants, which are able to gather certain elements in the form of chemical compounds from the soil and air, and with the aid of sunlight, manufacture plant products which are later used as animal foods.

The plant obtains water from the soil through the roots, and air is taken in by the plant through the minute openings called stomates on the lower side of the leaves; nitrogen, which is an important element in plant and animal nutrition, is obtained chiefly from the soil in the form of chemical compounds known as nitrates. However, leguminous plants such as lucerne, clover, and peas carry on their roots nodules which contain nitrogen-fixing bacteria which have the power of collecting free nitrogen from the air of the soil and supplying it to their host plants. Minerals such as phosphorus, potassium, and calcium are taken up as chemical compounds from the soil by way of the roots. Water supplies hydrogen and oxygen, and some oxygen is also obtained from the carbon-dioxide of the air, as is the carbon. All these substances are necessary for plant life and having obtained the required supply of these the plant is able to manufacture its various plant compounds which build up roots, stems, leaves, flowers, and seeds. The plant foods are carried to the leaves of the plant by the sap, and the green colouring matter of the leaves (chlorophyl), together with the sunlight, act on the plant foods in such a way as to change them into substances known as starches and sugars. Some of these compounds are then further changed into more complex substances within the plant and are used to build up plant tissue, to store up reserve tissue or to produce seed. These substances, produced by the plant, are known as carbohydrates, fats, and nitrogenous compounds.

Carbohydrates.

These consist of sugar, starch, and fibre and make up the larger portions of plants; they are fat, heat, and energy producing substances of animal foods. Sugars and starches are more digestible than fibre, and in grains they are more plentiful than fibre, whereas in hay the fibre content is about equal to that of starch and sugar.

Fats and Oils.

Fats and oils are similar in composition, but fats are solid under ordinary temperatures, while oils are liquid. These compounds are mainly the reserve food supply in the seeds of plants; they are particularly plentiful in peanuts, cottonseed, and linseed. Both carbohydrates and fats are composed of hydrogen, carbon, and oxygen, but carbohydrates contain approximately two and a-quarter times more oxygen than do fats, with the result that when they are burnt (oxidised) in the animal body the fats and oils give off approximately two and a-quarter times as much heat as do carbohydrates.

Nitrogenous Compounds.

By adding nitrogen and other elements to the carbohydrates, the plant builds up substances known as nitrogenous compounds or crude proteins. This group of substances includes proteins and amides or amino acids. Proteins are largely used in the production of milk, for growth and for reproduction in animals. Young plants which have not reached maturity contain a larger proportion of protein than older plants which contain larger quantities of fibre.

PLATE 128.
Grade Large White growers on a self-feeder at the Maroon Homestead Farm. They should be nicely finished when they reach bacon weights.

Mineral Matter.

Mineral matter is contained in all plants in varying degrees; the younger growth of plants has a higher percentage of useful minerals than the older portions. The chief mineral elements required by the animal are calcium and phosphorus, although several others are necessary in small quantities. When stock are fed on plants containing ample quantities of the necessary minerals, there may be no need to add more minerals to the ration, but in some cases, and especially where young or pregnant animals are being fed, the addition of a mineral supplement to the ration is an advantage. Several mineral mixtures are on the market and their use is often preferable to the farmer making his own, for they are usually complete and thoroughly mixed.

Iron as a Preventive of Anæmia.—A lack of iron in the sow's milk has been proved to be the cause of anæmia in young suckers, the anæmia being indicated by a paleness in the pigs, a wrinkling of the skin, and diarrhœa. The trouble occurs from the time the pigs are born until they commence to eat solid foods. Where sows and litters are run on pasture the anæmia does not occur, as the pigs receive iron from nosing in the ground, but in intensive pens where pigs have no access to soil, trouble may be anticipated unless precautions are taken. Simple means

of prevention when litters are penned consist of giving either a supply of mineral mixture containing sulphate of iron or a quantity of fresh soil or turf in the pen where the suckers have access to it.

Vitamins.

Vitamins are substances present in foodstuffs about which knowledge is, as yet, limited. It is known, however, that the vitamins, of which there are several known varieties, are essential to health, growth, and reproduction of animals; and if any one of them is not supplied in the foods, trouble will occur in the stock. As the various vitamins are present in most of the common stock foods, there is little risk of deficiency when a good variety of foods is given, and particularly when grazing is provided.

Salt.

Salt, as well as being a necessary compound in animal nutrition, is valuable as an appetiser, and for this reason it is used as the base of most commercial mineral mixtures for stock. An excess of salt has a poisoning effect on pigs.

Water.

Water is another essential for animal health, and all stock should receive all the water they require at frequent intervals. Water takes its part in practically every body function, and a large proportion of the body is made up of water. Where animals are fed excessively on very watery foods such as separated milk, they drink very little water, if any, but when dry foods are given, large quantities of water are required by pigs.

Air and Sunlight.

Fresh air and sunlight are both necessary for health and growth in stock, and it is advisable to allow animals access to both. It is also necessary to provide exercise to maintain normal functioning of the body.

Digestibility of Foods.

Although a chemical analysis of a food shows the quantities of crude protein, fats, fibre, and nitrogen-free extract the food contains, it does not indicate the proportions of the substances which are really available to the animal for nutrition. As only a portion of each nutrient is digestible, the remainder is lost from the animal body in the excreta. The food, on being taken into the mouth, is chewed and more or less ground to a finer consistency and mixed with saliva. It then passes on to the stomach and intestines, and it is subjected to the action of the various juices which are secreted in the body; bacteria also work on the food. This process dissolves the foods into compounds, some of which are then ready for assimilation.

Food nutrients are digestible to varying degrees, and the percentage of a nutrient that is digestible is known as its digestibility coefficient. The digestibility coefficients are determined experimentally by analysing foods, then feeding them to animals, and collecting all the excreta, which is then analysed, and the quantities of nutrients found to be left after digestion has taken place are said to be indigestible, and the differences between these quantities and the original quantities indicate what was digested by the animal. In considering the nutritive value of foods, it is the digestible nutrients that are used.

In practice the quantity of fibre in a food is a fairly good indication of its digestibility, fibre being very resistant to digestion.

Nutritive Ratio.

In calculating the nutritive value of a food, the percentage of digestible proteins, carbohydrates, and fats may be added together, after multiplying the fats by 2¼ to allow for their extra heat-producing capacity. The total is known as the total digestible nutrients.

If the sum of the digestible carbohydrates, plus fats multiplied by 2¼, be divided by the digestible proteins, the resultant ratio is known as the nutritive ratio. Different classes of stock require different nutritive ratios; for example, young growing stock and breeding animals require a greater proportion of proteins than do fattening stock.

Plate 129.
W. F. Kajewski's Piggery, Glencoe, via Gowrie Junction, where pigs are kept under grazing conditions.

The nutritive ratios of different foods vary; for example, separated milk, which is comparatively rich in proteins, has a ratio of 1 part proteins to about 1·4 parts of carbohydrates, plus fat x 2¼, and this ratio is stated as 1 : 1·4. Maize grain, which is particularly rich in carbohydrates, has a ratio of about 1 : 12.

Foods carrying a large proportion of proteins are called nitrogenous foods, and have a narrow nutritive ratio. Those carrying a large proportion of carbohydrates and fats are called carbonaceous foods, and have a wide nutritive ratio. Young growing pigs require about 20 per cent. of protein in their ration at weaning time, and by the time they are 150 lb. live weight their requirement is down to about 15 per cent. protein.

Palatability.

Foods which are pleasing to the taste of animals are said to be palatable. Palatability is affected not only by the actual composition and condition of the food, but by the custom of the animals which are being fed. For example, if pigs have been accustomed to eating maize grain on the cob, and are suddenly changed over to ground maize grain, they sometimes do not relish the change; and if the change had been reversed, this dislike would probably also have been noted. Foods which are very palatable to an animal stimulate digestion, and therefore give better results in feeding. Also, when maximum gains are desired it is wise to give a palatable food mixture to stimulate food consumption. Dry foods containing a large quantity of fibre are usually less palatable to pigs than succulent foods and good grain. When certain unpalatable foods are available cheaply and it is desired to make most use of them, the addition of some more palatable food will often increase the palatability of the ration.

Succulence.

Succulent foods, such as young growing green crops or root crops or grass pasture, are appreciated by stock, and have the additional advantage of acting as a laxative. The palatability of succulent foods increases their consumption, and so leads to greater production.

Variety.

It is important in animal feeding to give a variety of foods at all times. However, sudden changes of diet should not be made. When the animal regularly receives a good variety of foods in its ration, there is little risk of a deficiency of any of the necessary nutrients, and the ration is more palatable to the animal. Even when the feeder lacks a knowledge of the principles of feeding, if he gives the stock a sufficient variety of foods good results will usually be obtained.

Concentrates, Roughages, and Bulk.

Foods which contain a comparatively low percentage of fibre are known as concentrates. They are highly nutritious. The various grains, as well as pollard, meat meal, and linseed meal, would come under the heading of concentrates.

Roughages are foods such as fodder crops, pasture, hay, and silage, which contain a comparatively large quantity of fibre and little digestible nutrients. Foods such as root crops, pumpkins, and melons do not contain large quantities of fibre, but are watery, and for this reason are usually classed as roughages or bulky foods. Separated milk, buttermilk, whey, and soup are also classed as bulky foods as they contain a very high percentage of water, although their fibre content is nil.

Preparation of Feeding Stuffs.

Any benefit to be derived from the preparation of a food will depend on its character and condition and on the animal. With most foods cooking is unnecessary for pigs, exceptions being offal and English potatoes, also milk products which are suspected of carrying the tubercle bacillus. In cold weather pigs prefer warm food and drink, and this

should be attended to where practicable, as it will increase the palatability and help maintain the body heat, portion of which would otherwise be utilised to heat up the cold food in the digestive tract. While it is usually wise to force pigs to chew their foods, the small grains are more digestible when they are ground, crushed, or rolled, and even maize, which may be well chewed and digested at times, is often improved by grinding; although pigs, if accustomed to the method of feeding, will make economical use of maize either on the cob or as whole, shelled grain.

When the small, hard grains cannot be crushed, ground, or rolled, they should be soaked or boiled to soften. Lucerne chaff or hay is sometimes steamed or soaked to increase its palatability for pigs, although after pigs become accustomed to these foods they make good use of them dry.

Quantity of Food to Give.

The growth, appetite, and condition of the pigs are the feeder's best guide in determining quantities of food to use, but for convenience in calculation, the following may be taken as approximate requirements to produce rapid growth in pigs:—

Live Weight of Pigs.	Minimum Daily Allowance per Pig of Protein-rich Foods.		†Daily Allowance per Pig of Grain or its Equivalent.
	Sep. Milk or Buttermilk. or	*Meat Meal, etc.	
	Gallons.	Lb.	Lb.
20 lb.	¼	¼	½
40 lb.	¼	½	1
60 lb.	¾	½	2
80 lb.	¾	½	3
100 lb.	¾	½	4
120 lb.	¾	½	5
140 lb.	¾	½	5½
160 lb.	¾	½	6
180 lb.	¾	½	6½
200 lb.	¾	½	7
Brood Sows (Dry)	¾	½	5–6
Brood Sows with Litters (over two weeks)	1½	1	10–12

* When a minimum of ¾ gallon of separated milk or butter-milk daily per pig is available, there should be no necessity to use meat meal or similar protein-rich foods, excepting in the case of sows with litters, which require 1½ gallon of milk.

† When other foods are used to replace some or all of the grain allowance, it may be estimated approximately that 1 lb. of grain equals—

4 lb. Sweet Potatoes,
4 lb. English Potatoes,
5 lb. Arrowroot,
6 lb. Pumpkins,
8 lb. Mangolds,
5-10 lb. Green Pasture or Forage Crops,
1 gallon Separated Milk or Butter-milk (undiluted),
2 gallons Whey.

When pigs are receiving large quantities of protein-rich forage such as lucerne, cowpeas, or field peas, the maximum requirement of protein-rich food such as milk or meat meal will be less than shown above. It should be remembered in using bulky foods to replace grain

that pigs have a limited capacity for such foods, and better results are usually obtained by feeding at least some of the grain requirement as grain; this applies more to young pigs than to brood sows.

Good pigs which are full fed should gain an average of 1 lb. live weight daily from 20 to 100 lb. and require an average of 3½ lb. of grain equivalent to make that 1 lb. gain. From 100 to 200 lb. the average daily live weight gain should be approximately 1½ lb., with a food requirement of approximately 4½ lb. grain equivalent for each 1 lb. gain.

[TO BE CONTINUED.]

A CHEAP WINTER RUG FOR DAIRY COWS.

Where proper shelter is not provided for stock, not only is their resistance to disease reduced, but much food material is wasted in "warming the wind," or in other words meeting the increased demands of an exposed body. This fact has an important application for dairy farmers. A cow's food is only devoted to production after the animal has satisfied its needs for nourishment and heat. In assisting the cow to conserve the lastmentioned, shelter belts in the form of trees and hedges have considerable utility on the dairy farm, especially in colder districts and situations, and for the same reason the rugging of the animals during at any rate a portion of the winter is well worth while.

Many farmers would like to rug their cows, but cannot afford to purchase the market article. The farmer can, however, make his own cow rugs for little more than the cost of two or three cornsacks or other heavy bags, a ball of twine, and a sewing needle, plus his own ingenuity, points out a leaflet issued by the New South Wales Department of Agriculture. Two bags, or three for larger cows, will make an effective rug if utilised as follows:—

Split the bags down the seams and join together and place on the cow. Next cut off a strip from 10 to 18 inches wide so that the rug will not hang too low. This need not be wasted; it is folded, and when sewn to the rug provides the strap for the thighs, this being the only strap used. The front is now fitted by turning up the front corners and sewing them to the sides of the rug. This strengthens the rug and obviates the necessity for cutting off the spare portion which the cow would tread on. The two turned-back portions are then measured and sewn to fit fairly tightly to the cow's neck. The back strap is fitted 12 to 15 inches below the rump level, and the rug is complete.

This home-made rug will keep the cow warm, and after a few days' wear, when the oil, &c., from the cow's body has worked into the rug, it will also be waterproof. The rug can quite easily be slipped off and on over the cow's head, and it is advisable to remove it daily except on rainy or very bleak days. The cow's name painted on the rug over the rump with tar prevents confusion in replacing the rugs.

A trial on one or two cows will prove the efficacy of these rugs, the animals soon showing their appreciation in a practical manner.

Cockerel-raising Experiments.

Report by P. RUMBALL, Poultry Expert, and J. E. LADEWIG, B.Sc. Agric.

The White Leghorn fowl, by reason of its size and class, is not generally regarded as a table bird. In fact, as soon as chickens reach an age which enables sex to be determined, it is the general practice to destroy the cockerels. They are thus a total loss to the industry. If they could be reared economically to the "prime roaster stage," a small profit would be acceptable to the poultryman. These experiments, which were conducted at the Animal Health Station, Yeerongpilly, were designed to investigate the cost of raising cockerels on rations which can, in the main, be home-produced.

The tests were conducted with cockerels six weeks of age. One lot was reared in pens and one lot in batteries.—Ed.

PEN-REARING TESTS.

IN these tests 86 cockerels were used. They were divided into three groups of 28, 28, and 30 birds each.

These birds were reared in pens 5 ft. wide and 20 ft. long. Their liberty was considerably restricted in consequence.

Rations.

Simple rations were fed in two instances with the object of encouraging the utilisation of surplus supplies of skim milk and meals that could be made on the farm. The other ration was similar to that used by many commercial poultry farmers for the rearing of stock—

Group 1 were fed twice daily upon a ration composed of 80 per cent. maize meal and 20 per cent. semi-solid butter-milk.

Group 2 were fed twice daily a mash of 80 per cent. wheat meal and 20 per cent. semi-solid butter-milk.

Group 3 were fed upon an all-mash, which was kept constantly before the birds.

The average crude protein content of the different rations was as follows:—Group 1, 11·5 per cent.; Group 2, 14·7 per cent.; Group 3, 15 per cent.

Rate of Development.

Except during one week, fairly uniform growth was maintained in all pens up to the age of sixteen weeks; from this period onwards the

rate of development in one pen showed a marked difference, and with the object of illustrating the variation in the three pens, Table I. has been prepared:—

TABLE I.

SHOWING AGE, GROUP, AVERAGE WEIGHT OF BIRD, AND COST OF FEED PER BIRD.

Age.	Group 1. Maize and Milk.		Group 2. Wheat and Milk.		Group 3. All-Mash.	
	Weight of Bird.	Cost of Feed.	Weight of Bird.	Cost of Feed.	Weight of Bird.	Cost of Feed.
Weeks.	Oz.	*d.*	Oz.	*d.*	Oz.	*d.*
6 ..	17·3	..	17·1	..	17·9	..
16 ..	42·7	11·0	43·1	11·1	48·9	11·3
17 ..	46·7	12·2	47·1	12·4	55·1	12·6
18 ..	46·7	13·5	47·7	13·8	56·1	13·9
19 ..	51·6	14·9	52·6	15·6	58·2	15·1
20 ..	54·5	16·4	55·7	17·3	61·3	16·3
21 ..	55·1	17·9	56·0	18·6	60·6	17·4

From Table I. it will be noted—

1. That the birds fed on all-mash were as heavy at seventeen weeks as were those fed maize and wheat at twenty-one weeks.
2. That the cost of feeding from the age of six weeks until the cockerels attained the weight of 55 oz. was—All-mash, 12·6d.; wheat and milk, 17·3d.; maize and milk, 17·9d.
3. That the rate of development appeared to be somewhat associated with the crude protein content of the ration.

BATTERY-REARING TEST.

In this test sixty cockerels were used, penned in lots of 10.

The feeding was based upon the principle of the farmer using farm-grown and manufactured meals plus milk. In this test, as in the former, semi-solid butter-milk having a crude protein content of 20·8 per cent. was used. Approximately four times the quantity of skim milk would be necessary as a substitution for the semi-solid.

Rations.

——	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.	Section 6.
Maize meal	80	40	..	60	90	..
Wheat meal	..	40	80	..	5	50
Semi-solid milk	20	20	20	40	5	50
Crude protein content of ration	11·5	13·1	14·7	13·8	9·9	17·0

In addition to the above, green chaffed lucerne was fed once daily, and shell grit, charcoal, and water were kept before the birds at all times.

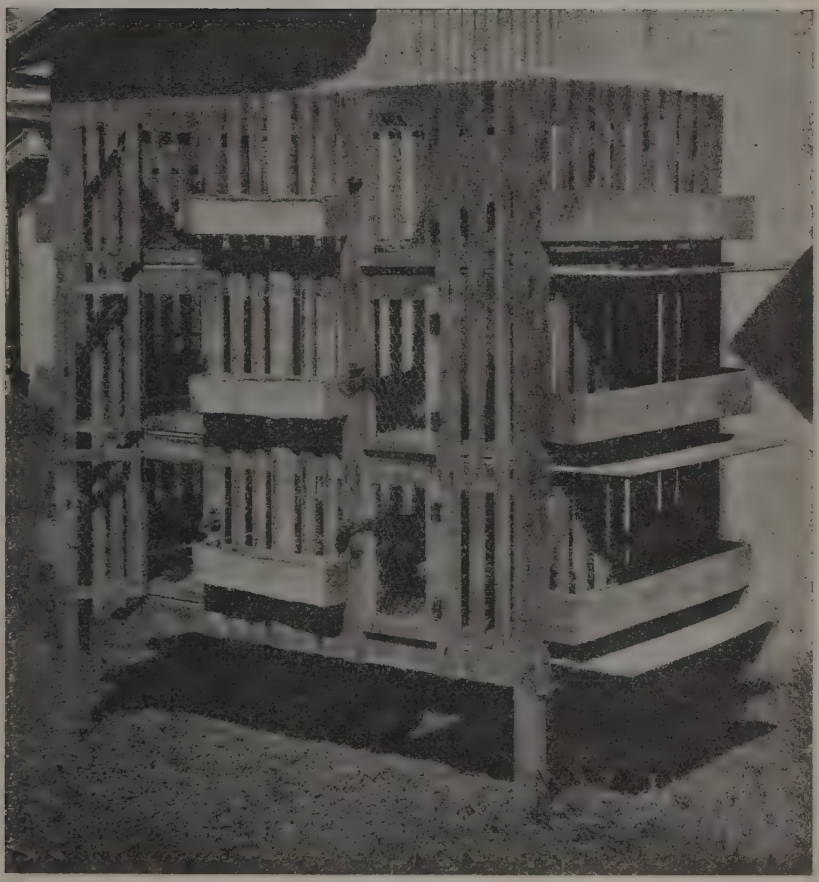

PLATE 130.

Battery used in the Cockerel-feeding Experiments, showing three decks, wire floors (with tray underneath to catch droppings), and outside feed and water vessels.

The quantity of food supplied was varied in accordance with the appetite of the birds. There appeared, however, to be a definite relationship between consumption and the butter-milk content of the ration, the rations having the higher content being favoured.

Rate of Development.

In order to indicate the progress development, Table II. has been prepared, commencing when the birds were fourteen weeks of age, as one group at this age were as heavy as the best group in the pen-rearing tests were at seventeen weeks.

TABLE II.

SHOWING AGE IN WEEKS AND WEIGHT OF BIRD IN OUNCES.

Weeks.	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.	Section 6.
	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.
14	40·5	39·2	38·7	49·7	37·5	56·3
15	43·2	41·2	40·5	52·0	39·3	59·6
16	46·2	43·8	44·4	55·1	43·1	63·3
17	47·0	44·2	47·0	58·2	46·0	66·3
18	49·7	43·1	47·0	58·4	48·4	66·1
19	51·4	43·7	47·3	59·3	49·7	65·9
20	53·8	50·4	49·2	61·8	52·0	66·6
21	55·2	55·7	53·3	61·7	53·1	65·4

From Table II. it will be noted that Section 6 attained the weight of 55 oz. in fourteen weeks. This ration had the highest protein content of any, and, as in the pen-rearing test, it is suggestive that rations of a relatively high protein content are more efficient for the rearing of cockerels for table purposes. This ration also contained the highest amount of butter-milk, which undoubtedly stimulated consumption.

The cockerels in Section 6 increased in weight between the ages of six and fourteen weeks by 39 oz., an average gain of nearly 5 oz. per week. During the next two weeks they put on 3 oz. per week in weight and then remained almost stationary. It appears, therefore, that the most economic stage of development is reached with this system of feeding when the bird is from 55 to 60 oz. in weight, and consequently should be disposed of at or about that weight.

The next section to reach the 55-oz. mark was Section 4. This ration had the third highest protein content, but its semi-solid milk content was twice that of Sections 1 and 3.

This additional quantity of milk undoubtedly increased consumption, with the natural consequence of more rapid development.

FINANCIAL ASPECT.

Every breeder has for his object the rapid development of cockerels for table purposes. Early development reduces the plant necessary, and the flesh of the young quick-grown bird is preferred to that of the older slow-grown bird.

In order to indicate the costs of production under the various systems of feeding adopted, Table III. has been prepared indicating the milk content of the ration, age, weight of bird, and cost in pence—

TABLE III.

Section.	Milk Content of Ration.	Weight of Bird.	Age.	Cost in Pence.
	Per cent.	Oz.	Weeks.	d.
6	50	56	14	13·8
4	40	55	16	14·3
2	20	55	21	15·2
5	5	53	21	12·5
3	20	53	21	14·6
1	20	52	21	15·6

From the foregoing table it will be noted that the cost of rearing cockerels in Section 6 to fourteen weeks of age was slightly greater than was the case in Section 5, where the birds were kept to the age of twenty-one weeks.

In determining the most economic rearing ration the breeder must take into consideration the cost of food, the time occupied to obtain results, and the condition of the flesh of the bird. When this is done the choice in this instance would be given to Section 6.

It must, however, be pointed out that where good results are obtained by feeding a relatively costly ration, the advantages gained can easily be lost by holding the birds for a week or so beyond the most economical period for marketing.

In these experiments the cost of rearing has only been given for the food used from the time the cockerel chickens were six weeks of age.

Cockerels are generally reared to the age of about six weeks with the pullets, then culled and sold. The market value at this age would be in the vicinity of three pence per chicken; therefore this amount should be charged to the costs.

The cockerels reared in the tests realised 1s. 9d. each. In the pen-feeding tests the best results were obtained for an expenditure on food of 12·6d. To this must be added the market value of the chicken at six weeks—viz., 3d. Therefore the profit over cost of feed was 5·4d. per bird.

In the battery tests, the most economical development was obtained for an expenditure in feed of 13·8d. Adding the value of the chicken brings the costs to 16·8d; consequently, the profit over costs in this instance was only 4·2d. per bird.

It naturally must rest with the farmer to decide whether the raising of cockerels of the Leghorn variety for market is justified. The prices realised for the birds from these tests are not encouraging, but it must be pointed out that the average value was depreciated by retaining some of the groups until the birds became a trifle staggy.

SUMMARY.

The results from these tests indicate—

That the battery system of rearing is efficient.

That the best results were obtained by the feeding of a ration carrying a slightly higher protein content than that usually used for growing pullets.

That as milk induces consumption and is a desirable protein-rich food, it should be used in all rations in some form when easily obtainable.

That variety in the ration appears to give the most economic results, and appears a necessity to increase economically the protein level.

Land for Grazing Selection.

SESBANIA RESUMPTION.

SESBANIA Resumption is situated from 20 to 30 miles northerly and westerly from Corfield, on the Hughenden-Winton Railway, and embraces three portions, with areas ranging from 30,000 acres to 46,500 acres. The blocks will be open at the Land Office, Hughenden, on Thursday, 7th June, for a term of lease of twenty-eight years, at annual rentals of two pence and one penny farthing per acre for the first seven years of the term.

Portions consist of high open downs, with well-shaded channel country along the creeks, and are well grassed with Mitchell, Flinders, barley, blue, and other grasses. The land is good fattening and wool-growing country, and two of the blocks are sufficiently shaded to make good lambing country.

Water supplies are obtained from three bores, two of which are flowing, and one block is already sufficiently watered.

Other improvements comprise a cottage, hut, yards, and fencing.

Each selection will require to be stocked to its reasonable carrying capacity with the applicant's own sheep within a period of three years, and proof must be furnished of the financial standing and pastoral or land experience of the applicants.

Free lithographs and full particulars may be obtained from the Land Agent, Hughenden, the Land Settlement Inquiry Office, Brisbane, and the Government Intelligence and Tourist Bureaux, Sydney and Melbourne.

Queensland Weeds.

By C. T. WHITE, Government Botanist.

MIST FLOWER (Eupatorium riparium).

Description.—A spreading herbaceous weed with numerous stems to a single plant, the stems decumbent at the base and rooting at the lower nodes. Leaves opposite, lanceolate in outline, varying somewhat

PLATE 131.
Mist Flower (*Eupatorium riparium*).

in size, but the adult ones mostly about 3 inches long and 1 inch wide, tapering at the base into a slender leaf stalk or petiole of about 1 inch; margins deeply and coarsely saw-toothed. Flowers white, the individual flowers very small and borne in small dense heads, the heads arranged in terminal sprays or corymbs 3 inches or more across. Seeds (achenes) slender, one line long, angular and hairy on the angles, surmounted by about twenty fine white hairs (pappus); the hairs themselves very finely barbellate or plumose.

Distribution.—A native of Mexico introduced into Queensland as a garden flower, now established as a weed along streams and in wet places generally in South-eastern Queensland.

Botanical Name.—*Eupatorium* commemorates Eupator, King of Pontus, who is said to have used a plant of this genus in medicine; *riparium* (Latin), referring to its preference in growing along creek banks.

Properties.—It is not known to possess any harmful or poisonous properties. It is frequently grown in bush-houses and in shady flower beds as an ornamental plant. In Europe and North America it is cultivated to a limited extent as a florists' flower.

Eradication.—So far as I have personally observed, the plant is confined to creek banks and wet situations generally. The plant has been gazetted a noxious weed, however, at the request of the Nerang Shire Council, who report it to be a serious pest on farms in the wetter country towards the ranges in their shire.

When the weed is too abundant to be dealt with by hand-pulling or hoe-chipping, it should readily succumb to an application of weak arsenical spray. Where the use of arsenic is undesirable on account of grazing stock, "Weedex" or other sprays containing calcium chlorate could be used. For plants such as Mist Flower a 2½ per cent. solution should be sufficient. The Agricultural Chemist (Mr. E. H. Gurney) advises that though reports have been received stating both sodium and calcium chlorates are safe so far as stock are concerned (stock having been grazed without ill-effects in paddocks where vegetation has been sprayed with these substances), care should be taken that stock are not allowed to get at tins containing the concentrate or unused spray.

Botanical Reference.—*Eupatorium riparium* Regal in "Gartenflora," vol. xv., p. 324, tab. 525.

TO SUBSCRIBERS—IMPORTANT.

Several subscriptions have been received recently under cover of unsigned letters. Obviously, in the circumstances, it is impossible to send the Journal to the subscribers concerned.

It is most important that every subscriber's name and address should be written plainly, preferably in block letters, in order to avoid mistakes in addresses and delay in despatch.

Agricultural Notes.

By H. S. HUNTER, Agricultural Branch.

Seasonal Prospects.

THE month of April opened with rains which were welcome owing to the dry conditions of March. Unfortunately, the Darling Downs, where a good downpour was most needed, received but little benefit, and the falls which were recorded in that area were of a very scattered nature. Further rains west of the range would permit of the sowing of early wheat and other winter-growing cereals, and provide a start for crops sown in some instances on a dry seed-bed. In many cases, on the heavy soils, the breaking-up of the land is being delayed owing to its hard condition, due to the compacting action of the heavy January-February rains followed by the dry conditions of March.

In the coastal districts the rains persisted throughout the first two weeks of the month and, between waterlogging and the absence of sunlight, a good deal of injury was occasioned to ripening root, grain, and fruit crops. Flooding again occurred in the far-northern areas, and minor floods were experienced in local areas in the South.

Sugar.

With continued rains and fair atmospheric temperatures, the progress of the cane crop was reasonably satisfactory in all areas. The backward cane in the far North has shown but little recovery, however, and excessive rains during the month of April have further spoiled its chances of making good. Grub damage is making itself evident from Innisfail to Cairns, and large areas have been completely destroyed by the pest.

The Burdekin and Mackay areas promise heavy crops for the coming harvest; in the former area, particularly, the yield per acre may exceed the high figure attained in 1933.

The well-drained soils of the southern districts have benefited from the continued heavy rains, and crop growth on these areas has been fully maintained until the recent cold spell. Where drainage is not satisfactory the crop has suffered, and water-logging is serious.

On the whole, the Queensland crop would appear to be well up to the average of recent years. More precise data in this respect will be gathered during May.

Maize.

The harvesting of the mid-season maize crop now is in full swing, and some excellent yields are being obtained. The late-sown crop also holds good promise, except in the Darling Downs areas, where the yield will be affected by lack of rain. All maize-growing districts in Southern Queensland yielded a good crop of early maize, and the total yield for the season should be well above the average. Unfortunately, market prices are at a low level, and, as a consequence, many growers are storing their grain for use on the farm or until prices improve.

Wheat.

Practically all of the season's wheat now has been delivered to the Pool. The quantity received up to the first week of April amounted to 3,936,806 bushels. The total yield should be in the vicinity of 4,350,000 bushels.

Cotton.

The harvesting of the cotton crop continues at a good rate. Very heavy receivals are arriving daily, particularly at the Glenmore ginnery, where over 3,000 bales have already been ginned. Owing to the better yields in the Central district it has been found necessary to reopen the Gladstone ginnery, where good consignments are steadily arriving. Whilst the rate of receivals has not been so heavy at the Whinstanes ginnery, it is anticipated that more than a normal crop will be treated there, as reports from the various districts indicate nice yields except in the more southern sections, where climatic and insect troubles have lowered the season's crop, particularly in the Central district, is better than that of last year.

Dairying.

The output of dairy products is now suffering a seasonal decline, but the season's production will eclipse all previous records. Queensland this season has displaced Victoria as the chief butter-exporting State of the Commonwealth. Victoria's exports, which, up to 18th March last, amounted to 27,487 tons, are 11,149 tons less than for the corresponding period of last year. The falling-off can be attributed, no doubt, to the heat wave conditions which occurred on two occasions in the southern part of the continent. Queensland, with the assistance of an unusually favourable season, has increased its exports in the same period by 4,515 tons to a total of 28,855 tons.

The attention of statesmen and dairymen has again been directed to the question of restricting exports of butter. The principle of the restriction of production of primary products is a world-wide and, in Australia, a momentous question of concern, not only to the producer but to the whole community. Practically every product exported from Australia is either subject to or threatened with some measure of restriction from forces operating beyond the borders of our country.

Potatoes and Arrowroot.

Both of these crops suffered to some extent in the coastal districts, particularly in badly drained localities, from the continuous wet weather early in the month. Shortage of supplies from the Southern States has resulted in an appreciable rise in potato values on the local market, and as the crops of Victoria and South Australia suffered from the heat wave, the Queensland crop should meet with good prices when it comes on the market.

The arrowroot crops on the South Coast were adversely affected by rain on the lower areas. On the higher ground good yields should be harvested, but decreased areas and unfavourable conditions may result in the total yield being about 200 tons less than that of last year.

Tobacco.

The curing of tobacco leaf is being carried out in most districts, but the total yield will be considerably less than in 1933. With the current season, many areas of land which have proved their unsuitability have been abandoned or devoted to other crops. The season was far from suitable for the raising of seedlings, mainly owing to the prevalence of blue mould. In numerous instances growers who had failed to raise seedlings in their first attempt later succeeded by adopting the use of sprays recommended by the Department, but many of these beds were sown very late in the season, and it is feared that the growers concerned have little chance of harvesting a satisfactory crop.

French Beans.

Supplied by the Fruit Branch.

A CONSIDERABLE variety of beans is grown in Queensland, but it is generally recognised that, for all-round commercial purposes, the Canadian Wonder holds first place. Another variety, Feltham's Prolific, reputably hardy and a good cropper in New South Wales, is grown fairly extensively in some districts, but an unbiassed comparison of the two varieties from all aspects leaves the balance in favour of Canadian Wonder.

Planting usually takes place from September to April, though sowings may be made earlier according to the district's susceptibility to frosts.

In many parts of the State great difficulty is experienced in raising a crop during the hot months due to the ravages of a small fly for which up to the present there is no satisfactory control. During the colder months this pest disappears, and in the coastal districts free from frosts planting may be done at this period. The hilling of the plants, after they are about 6 to 7 inches high, at times assists in partially overcoming the damage caused by the fly. Rotation of crops and destruction of all plants after the crop is harvested are helpful in disease and pest control.

In preparing the land for market garden crops, along with cultivation, they generally require the free use of well-rotted stable or other manure, but in the case of beans the application of a heavy coat of such manures often results in the plants producing an abundance of foliage with resultant loss of bean pods. Beans, therefore, are suited by a well-cultivated soil, and preferably one that has been manured for a preceding crop. Failing this a light dressing of artificial manures rich in phosphates or potash will have a beneficial effect.

The Agricultural Chemist, in his pamphlet on Complete Fertilizers, advises:—Beans grow well on almost any soil, but prefer a well-drained clayey loam. Like all leguminous crops beans require lime, and the soil should contain a fair amount of this plantfood. Apply per acre, according the quality of the soil:—

None to ½ cwt. of nitrate of soda; 2 to 3 cwt. Nauru phosphate—superphosphate mixture; ¾ to 1½ cwt. of sulphate of potash.

When the beans are grown to be eaten green, the amount of nitrogenous manure can be considerably increased, using 1 cwt. of nitrate of soda applied in three or four portions as top dressing, which greatly improves the succulence and flavour of the pods. Use from 3 to 6 cwt. of a 0-14-8 or 2-12-6 mixed fertilizer per acre.

For use in gardens apply per square yard: ¼ oz. nitrate of soda; 2 oz. superphosphate; 1 oz. sulphate of potash; or 3 to 4 oz. of the 2-12-6 mixture, followed by two or three top dressings of ¼ oz. nitrate of soda.

Planting is usually done by striking out shallow drills and dropping the seeds by hand and covering by light harrowing. The rows are usually 2 feet 6 inches to 3 feet apart, with 6 to 8 inches between the plants, and 35 lb. of small or 52 lb. of large seed is sufficient to plant an acre.

Horse cultivation is usually carried out, but it is not advisable that this work should be commenced in the early morning or at any time when the crop is wet, as the spores of certain diseases are more easily carried under these conditions.

Weeds should be kept in check, as they will seriously affect the growth of the crop.

The maximum output of beans can only be gained by picking thoroughly as they become fit, that is, when young and tender; otherwise they will begin to form seed, and the plants will cease to bear marketable beans.

Medicinal Value of the Pineapple.

A RECENTLY published report by Dr. J. R. Killian,* the distinguished American scientist, on the nutritional value of canned pineapple, indicates that this popular fruit may be extensively used by doctors and dentists in their fight against pyorrhœa. Dr. Killian's report, which is the result of two years' research at the University of Hawaii, has, amongst other things, established canned pineapple as one of the most consistently reliable anti-scorbutics available throughout the seasons. Dr. Hanke, of the University of Chicago, has found, during an intensive study of dental disease and diet, that many striking cures of pyorrhœa and dental decay have been effected by the consumption of large quantities of anti-scorbutics, which are rich in vitamin C. Canned pineapple, it has been established, has as high a vitamin C content as the anti-scorbutics used in Dr. Hanke's experiments, and has also a high content of vitamins A, B, D, and G.

In experiments undertaken in connection with the Indian disease, beri-beri, which is a nutritional disorder, canned pineapple was found to contain the vitamin B (B1) in sufficient quantities to prove very valuable in combating the disease. Canned pineapple, the report adds, was found to be a good source of iron, copper, and manganese, essential to a proper diet, in a readily assimilable form. Test meals were given to a large number of subjects, and it was found that the incorporation of pineapple in the meal stimulated the protease activity in the stomach and definitely speeded up digestive process.

While the vitamin content of fresh vegetables varied considerably with the season of the year, the report adds, the vitamin content of pineapple was not injured by canning, and maintained a consistent level throughout the season.—"The Agricultural Gazette" of New South Wales.

* "Australian Food Manufacture," 5th January, 1934.

PLATE 132.
The Barron Falls, North Queensland.

PLATE 133.
Lake Barrine, bordered by dense tropical jungle, Atherton Tableland, North Queensland.

PLATE 134.
The Barron River near Kuranda, North Queensland.

PLATE 135

Outlook from Wootha, near Maleny, South Queensland, the Glasshouse Mountains in the distance,

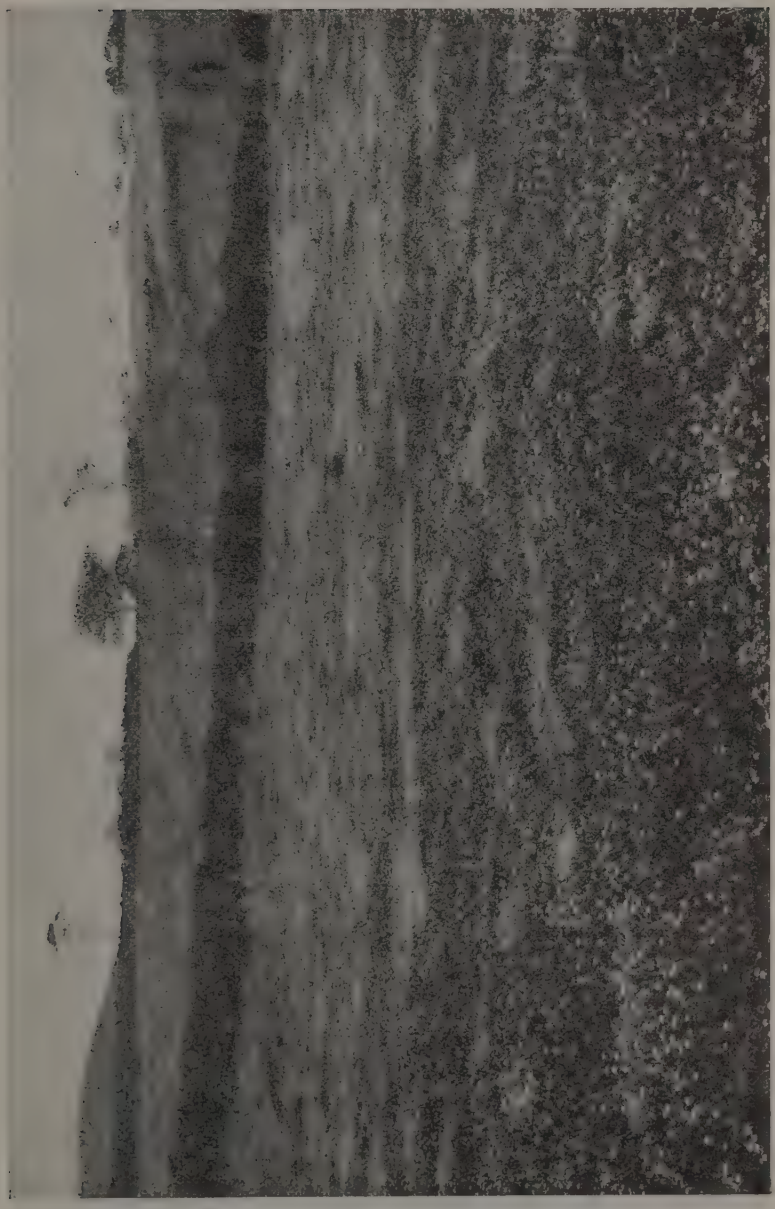

PLATE 136.
A field of clover, Mr. Cole's home farm, Maleny, South Queensland.

PLATE 137.
A banana plantation on Buderim Mountain, Queensland.

LIST OF LICENSED BRISBANE FARM PRODUCE AGENTS.

Addis Bros.
Allen, J.
Anderson, Edward Arthur
Archer and Goss
Arkell, W., and Sons
Australian Fruit and Produce Co.
Barnes and Co., Pty. Ltd.
Barr, Alexander S.
Barron, Orr, and Co., Pty. Ltd.
Barter, G. and W.
Bowden, T. S., and Co.
Brabant and Co.
Burns, Philp, and Co., Ltd.
Burrell, Fenton, and Co., Pty. Ltd.
Carseldine, Arthur W.
Carter, Alfred J.
Chave, Alfred E.
Clark and Jesser
Collard and Mackay
Comino Bros. Pty. Ltd.
Committee of Direction of Fruit Marketing
Cooksley, Jack Royston
Cooksley and Co.
Cooper Bros.
Cranley, J. P., Pty. Ltd.
Cripps, William
Dairy Products Co-op. Co. Ltd.
Dalgety and Co. Ltd.
Davies, W. C., and Co.
Dean, Henry, and Sons, Pty. Ltd.
Edward, George
Eriksen, Hans P.
Evans, Arthur L.
Evans, Norman
Farmers' Co-op. Distributing Association of Queensland, Ltd.
Foggitt, Jones, Pty. Ltd.
Foley Bros., Ltd.
Fong Pie and Co.
Francis, Frederick W.
Gall, George
Geeves, Hedley, Ltd.
Gesler, Frederick C.
Good, D. E.
Granite Belt and Coastal Fruit Agency
Guinsberg, Israel
Hall and Pascoe
Harris, H. N., and Co.
Hodges and Pratt
Hutton, J. C., Pty. Ltd.
Izatt and Johnson
Jacklyn and Jacklyn
Jackson, J., and Co. (Produce and Seeds), Pty. Ltd.
Johnson and Markwell, W.
Johnston, Adam
Johnston, Reginald W.
Johnston, William
Jordan, Ernest Arthur
Justins and Finlayson
Laidlaw and Co., G.
Lambert, G. and W.
Leavy, James H.
Livingstone, J. R.
Luxford, S.
Mackay, William M.
Mant, Charles O.
Martin, Duncan G.
Martin and Co.
Matthews, John
Mendoza and Wright, Pty. Ltd.
Murray Bros.
Murray, John
McCausland, Louis J.
McCook Bros.
McCowan and Hammond
McDowall, Edward
New Zealand Loan and Mercantile Agency Co., Ltd.
Nicholson, Alphonso
Pettigrew and Wilson
Plint, H. C.
Potter, W. E.
Queensland Fruit Distributors
Robinson and Laidlaw
Robsons, Ltd.
Russell, H. M., and Co., Pty. Ltd.
Scott, Garrad, and Co.
Sellars, Derek P.
Sellars, R. B.
Shay, Percy Robert
Sibley, P. C.
Siemon, W., and Sons, Pty. Ltd.
Skinner, P. J.
Spence, J. W.
Stanton Bros.
Stanton, Harry
State Produce Agency Pty. Ltd.
Stewart and Walker
Sutton Bros.
Tacey and Evre
Thorpe, H. W.
Wanless, Thomas H.
Watson, W. P., and Co.
Whatling, E. H. R.
Wiltshire, F. C. G.
Winters, E.
Wool, A. E.
Wool, H. L.
Yow Sang and Co.

LIST OF LICENSED COUNTRY FARM PRODUCE AGENTS.

Backhouse, J. J. C., Killarney
Baker, G. H., Stanthorpe
Barben, F. J., Gladstone
Berlin, E. A., Marburg
Black, H. L., Mackay
Bramble, J. G., Rockhampton
Brand, Thomas, Mackay
Curtis, W. E., and Co., Bundaberg
Dawson Joseph, Rockhampton
Dimind, A. B., Mackay
Ellwood, E. A. Killarney
Elwing, J. A., Rockhampton

List of Licensed Country Farm Produce Agents—*continued.*

Featherstonhaugh, Albany, Roma
Foley, P. J., Mackay
Goltz, F. W., Mackay
Good, D. E., Rockhampton
Gore, Edward, and Co., Oakey
Gower, H. R., Rockhampton
Griffiths, G. H., Rockhampton
Haigh, E. V., Ipswich
Harding and Walker, Ipswich
Heers, J. W., Coominya
Jones, J. E. L., Gladstone
Joyner, R. G., Gladstone
Lee Sang and Co., Cairns
Leonard, T. J., Mackay
Leong Sun, Townsville
Limpus, Bert, Bundaberg
Limpus, C. M., and Co., Bundaberg
Lindemann, C. H. D., Lowood
Lymburner, E. A., Cairns
Mackay District Co-op. Fruit, Vegetable, Poultry, Bacon Association, Ltd., Mackay
Manz, Walter, Lowood
Mar Kong, Townsville
Maxwell, Samuel, Warwick
Melrose and Fenwick Pty. Ltd. (trading as Townsville Fruit Exchange), Townsville
Moynehan, W. J., Imbil
Olsen, A. E., Killarney
Poll and Co., Wynnum Central
Profke, Albert, Lowood
Ransome, V. W., Warwick
Reason, S. C., Warwick
Redmonds Pty. Ltd., Bundaberg
Reeds Pty. Ltd., Maryborough
Rex, J. W., Maryborough
Reye, C. A. H., Townsville
Richardson, A. N., Rockhampton
Robinson, John, Toowoomba
Stay, W. H., Toowoomba
Tatnell, W. R., Gympie
Thomas, D. B., Gympie
Thomas, George, Gympie
Thomas, L. J., Gympie
Thompson, Sydney, Warwick
Thorpe, T. E., Cairns and Townsville
Tong Sing and Co., Cairns
Tung Yep, Cairns
Turner, George Baden Powell, Bowen
Walker, E. E., Gympie
Walker, Shaw, Townsville
Walters, W. J., Lowood
Warrys Pty. Ltd., Maryborough
Waters, Punzell, and Williams, Mackay
Willie Young, Rockhampton
Wilson, John, Kingaroy
Wright, D. C., Charleville

PLATE 138.
Main street, Biloela—the centre of a progressive cotton-growing district, Queensland.

QUEENSLAND SHOW DATES, 1934.

May.

Taroom, 1st and 2nd (Camp Draft, 5th)
Dalby, 3rd and 4th
Beaudesert, 2nd and 3rd
Nanango, 3rd and 4th
Blackall, 7th to 9th
Chinchilla, 8th and 9th
Charleville, 8th to 10th
Crow's Nest, 9th and 10th
Boonah, 9th and 10th
Monto, 9th and 10th
Kingaroy, 10th and 11th
Ipswich, 15th to 18th
Miles, 16th
Kilkivan, 16th and 17th
Mitchell, 16th and 17th
Mundubbera, 16th and 17th
Dirranbandi, 16th and 17th
Wondai, 17th and 18th
Roma, 22nd to 24th
Gympie, 23rd and 24th
Emerald, 23rd and 24th
Biggenden, 24th and 25th
Murgon, 24th to 26th
Toogoolawah, 25th and 26th
Kalbar, 26th
Goomeri, 29th and 30th
Biloela: 31st May and 1st and 2nd June.
Wallumbilla: Cancelled.

June.

Maryborough, 1st, 2nd, and 4th
Marburg, 1st and 2nd
Childers, 5th and 6th
Gin Gin, 5th and 6th
Bundaberg, 7th to 9th
Lowood, 8th and 9th
Bororen and Miriam Vale, 11th and 12th
Gayndah: 13th and 14th
Wowan, 14th and 15th
Rockhampton, 19th to 23rd
Mackay, 26th to 28th
Laidley, 27th and 28th

June—*continued.*

Proserpine, 29th and 30th
Townsville Camp Draft, 30th
Mount Larcom: No Show.

July.

Bowen, 4th and 5th
Gatton, 4th and 5th
Kilcoy, 5th and 6th
Ayr, 6th and 7th
Townsville, 10th to 12th
Woodford, 12th and 13th (Sports only)
Rosewood, 13th and 14th
Cleveland, 13th and 14th
Cairns, 17th to 19th
Charters Towers, 18th and 19th
Caboolture, 20th
Nambour, 18th and 19th
Atherton, 24th and 25th
Barcaldine: 24th and 25th
Esk: 27th and 28th
Pine Rivers, 27th and 28th

August.

Royal National, 6th to 11th
Home Hill, 31st August and 1st September

September.

Enoggera, 1st
Imbil, 7th and 8th
Ingham, 7th and 8th
Pomona, 12th and 13th
Innisfail, 14th and 15th
Beenleigh, 20th and 21st
Mareeba, 20th and 21st
Rocklea, 22nd
Malanda, 26th and 27th
Kenilworth, 29th

October.

Southport: 5th
Millaa Millaa, 5th and 6th
Tully, 12th and 13th

IMPORTANCE OF MODERN DAIRY BUILDINGS.

Apart from the fact that the law imposes certain obligations on persons who erect dairy farm buildings, there are many other good reasons why these premises should be built according to well-designed plans. Among the reasons in favour of better dairy farm buildings are—They afford more protection from contamination for milk and its products. They help towards greater efficiency and economy. They are easier to maintain and to keep clean. They ensure better quality products by improving ventilation, cooling capacity and light.

PRODUCTION RECORDING.

List of cows and heifers officially tested by officers of the Department of Agriculture and Stock which have qualified for entry into the Advanced Register of the Herd Book of the Australian Illawarra Shorthorn Society and the Jersey Cattle Society, production charts for which were compiled during the month of March, 1934 (273 days period unless otherwise stated).

Name of Cow.	Owner.	Milk Production.	Butter Fat.	Sire.
		Lb.	Lb.	
AUSTRALIAN ILLAWARRA SHORTHORN.				
Mature Cow (over 5 Years), Standard 350 Lb.				
Linda 8th of Kilbirnie	Macfarlane Brothers, Radford	14,335·3	562·576	Mowbray 2nd of Kilbirnie
Dot of Frenchview (257 days)	W. J. Freeman, Rosewood	11,243	436·783	Jubilee's Admiral
Foremost 2nd of Blacklands	A. Pickels, Wondai	11,505·3	422·425	Sir Hugh of Hillview
Charm II. of Bri Bri	A. E. Vohland, Aubigny	11,533·9	422·366	Gay Boy of Tyrone
Pearl 11th of Quarnlea	Lehfeldt Bros., Kalapa	10,273·49	384·912	Lord Nelson of Blacklands
Ethel 11th of Raleigh	A. Pickels, Wondai	11,052·2	362·944	Democrat of Raleigh
Biddy 5th of Railway View	H. Embrey, Rosewood	9,546	355·531	Elected of Railway View
Senior, 4 Years (over 4½ Years), Standard 330 Lb.				
Venie of Wilga Vale	C. O'Sullivan, Greenmount	12,685·46	511·939	Reliance of Blacklands
Junior, 4 Years (under 4½ Years), Standard 310 Lb.				
Madam 3rd of Cedar Grove	H. Embrey, Rosewood	8,777	370·692	Duke of Cedar Grove
Dell of Cedar Grove	H. Embrey, Rosewood	7,692·5	325·522	Mabel 2nd's Victor of Coral Grange
Blacklands Strawberry 6th (266 days)	A. M. Johnson, Gracemere	8,429·68	320·293	Governor of Blacklands
Senior, 3 Years (over 3½ Years), Standard 290 Lb.				
First 21st of Quarnlea	Lehfeldt Bros., Kalapa	11,507·78	431·621	Nugget's Lad of Hillview
Flirt of Glengallan	R. Tweed, Kandanga	9,806·1	381·017	Nobleman of Blacklands
Cedargrove Shamrock 17th (268 days)	W. J. Freeman, Rosewood	7,593	328·303	Duke of Cedar Grove

JUNIOR, 3 YEARS (UNDER 3½ YEARS), STANDARD 270 LB.				
Woodlyn Lily	J. Lyndon, Worongary	11,309·89	458·029	Spanker of Glenrock
Thelma 5th of Blacklands	A. Pickels, Wondai	7,636·6	317·774	Fussy's Monarch of Hillview
Ettie 7th of Blacklands	A. Pickels, Wondai	7,464·7	308·904	Governor of Blacklands
SENIOR, 2 YEARS (OVER 2½ YEARS), STANDARD 250 LB.				
Trevlac Mayflower (266 days)	W. J. Freeman, Rosewood	7,657·5	311·098	Butterboy of Railway View
JUNIOR, 2 YEARS (UNDER 2½ YEARS), STANDARD 230 LB.				
Navillus Myrtle	C. O'Sullivan, Greenmount	7,901·26	336·479	Midget's Sheik of Westbrook
Cedar Grove Ivy 13th	C. O'Sullivan, Greenmount	6,774·76	282·891	Duke of Cedar Grove
Miss Myrtle 2nd of Blacklands	A. Pickels, Wondai	7,757·8	259·75	Limelight of Parkview

JERSEY.

SENIOR, 4 YEARS (OVER 4½ YEARS), STANDARD 330 LB.				
Flo of Roschill	F. R. Nimmo, Rosewood	9,703·5	541·001	Raleigh's Lad of Rosehill
SENIOR, 3 YEARS (OVER 3½ YEARS), STANDARD 290 LB.				
Glenmah Victor's Irene	F. A. Maher, Indooroopilly	6,597·47	333·655	Retford Victor's Noble
Glenmah Victor's Matilda	F. A. Maher, Indooroopilly	6,365·57	318·223	Retford Victor's Noble
JUNIOR, 2 YEARS (UNDER 2½ YEARS), STANDARD 230 LB.				
Bellegarth Princess Chime	D. R. Hutton, Cunningham	6,129	308·629	Bellefaire Blonde's Bellringer
Bellegarth Rosalie	D. R. Hutton, Cunningham	4,618·75	263·223	Bellefaire Blonde's Bellringer

Answers to Correspondents.

BOTANY.

Replies selected from the outgoing mail of the Government Botanist, Mr. Cyril T. White, F.L.S.

Bassia Burr.

INQUIRER (Brisbane)—

The only satisfactory means we can think of for the eradication of the Bassia Burr is the ordinary one of cutting off, stacking together, and burning. If the area is a large one, possibly there is some gear on the station that can be used for the purpose. If the plants are cut off at the present time or broken down and raked together, I do not think there is any chance of the old roots shooting again. Of course care should be taken not to distribute the seeds of the plant any more than possible in the process of raking-up.

Western Grasses and Plants.

G.C.B. (Longreach)—

Astrebla pectinata, sometimes called the Upright Mitchell.

Astrebla lappacea, usually called Curly Mitchell.

Astrebla squarrosa, Bull Mitchell. As mentioned there is another variety of Mitchell, namely *Astrebla elymoides*. This is the variety which is generally called Weeping or Hoop Mitchell.

Iseilema membranacea, Flinders Grass, tall variety.

Iseilema actinostachys, Flinders Grass, dwarf variety.

Eulalia fulva, Brown Top. This grass has been very highly spoken of as a fodder in New South Wales and by some authorities in Queensland, but so far as we have observed stock do not take readily to it. Have you noticed stock eating it at all in your district?

Dactyloctenium radulans, Button Grass.

Atriplex Muelleri. This apparently is the commonest Salt Bush in most parts of Western and Central Queensland. So far as we have observed it is not eaten by stock to any great extent. Stock very often prefer these salt bushes when they are dying off rather than when they are green and luxuriant.

Acacia farnesiana, Mimosa.

Feather Top.

F.W. (Lanefield)—

The specimen is *Chloris virgata*, a grass very closely allied to the common Rhodes Grass (*Chloris Gayana*). It does not, however, seem to possess the palatability of Rhodes Grass, and where Rhodes can be grown has no advantage over it. Though a very luscious-looking grass, our experience has been that stock reject it when other feed is available. We have heard, however, that it makes excellent hay, and that in this form stock eat it readily enough. The only local name we have heard applied to the grass is Feather Top.

Guinea Grass.

H.D. (North Arm, N.C.L.)—

The grass is *Panicum maximum*, Guinea Grass. This grass was cultivated rather extensively some years ago as a fodder, but went out of favour, perhaps on the introduction of Paspalum. There is no doubt that Guinea Grass is relished by stock, and we think a small paddock, say 2 to 5 acres, of grass such as this and Blue Panic should make a great standby for dairymen. The grass is frost-tender, but this may not trouble you at North Arm. It is propagated from seed or roots, but the seed, though produced in abundance, give a low percentage of germination. To obtain the best results the grass must be either fed or cut down.

Grasses and Plants Identified.

G.L.T. (Goodwood)—

Eragrostis diandra, a Love Grass. The name Love Grass is applied in a general way to species of the genus *Eragrostis* on account of their beauty.

Erigeron linifolius, Peg Weed, also called Rag Weed, though this latter name belongs more correctly to another plant.

Acacia Cunninghamii (?), as far as can be told from the specimen. The spikes were rather young to be certain. This wattle is often called Black Wattle in Queensland.

Rhynchospora sp., a species of Sedge. Under separate cover I am posting you a book by the late F. M. Bailey which gives the distinctions between grasses and sedges.

Eragrostis australiensis (?), as far as can be told from the rather small specimen. This particular Love Grass is known as the Beach Love Grass because it commonly grows over the sand dunes.

Alloteropsis semialata, Cockatoo Grass.

Eragrostis leptostachya, Paddock Love Grass.

Aristida sp., a three-pronged Spear Grass. We cannot give you the species as the seeds were badly smutted, but the genus is a large one and the seeds are rather troublesome to stock, especially sheep, sometimes working right under the skin and sometimes even into more vital parts of the animal.

Eragrostis elongata, a Love Grass.

Eucalyptus trachyphloea, the White Bloodwood. This determination is as far as can be told from the specimen. With Eucalypts or Gum trees it is always advisable to add a note on the bark, whether rough and flaky, stringy, smooth, &c.

Themeda australis, Kangaroo Grass.

Echinochloa colona, sometimes called Wild Millet, a grass very widely spread over the warm regions of the world and very closely allied to such well-known fodders as White Panicum and Japanese Millet.

Acacia flavescens, a wattle for which we have heard no very distinctive local name. We would be very glad to have local names for any of the specimens you care to send, because common names must come from people in the bush and not from the botanist.

There is no very comprehensive work on Australian trees, flowers, and grasses of a popular nature. Most of the comprehensive ones are technical, but there are a few cheap little nature study books you could get. For the wildflower study of your locality the best little book I think would be "Flowers of Our Bush," by Mrs. L. Thomson, price 2s. 6d. For grasses the best book would be "Grasses and Fodder Plants of New South Wales," by E. Breakwell, price 6s. Although this deals with New South Wales, most of the grasses mentioned occur in Queensland. A work recently issued, containing illustrations and descriptions of over 200 different sorts of orchids, ground and epiphyte, is "Gems of the Bush," Sun Nature Study Book No. 5, price 6d. For general botany you would find "The Story of Our Plants," by Miss C. le Plastrier, price 2s., a useful little work. A book on weeds is "Weeds and Poisonous Plants of Queensland," by F. M. Bailey, price 4s., obtainable from this office.

Caustic Creeper.

J.S. (Whetstone, S.W. Line)—

The specimen is the Caustic Creeper, *Euphorbia Drummondii*, a plant very common in Queensland and very widely distributed through New South Wales and the Northern Territory. It is generally regarded as poisonous to stock, though reports about it are conflicting. So far as we have seen, ordinary paddock stock seem to browse among the plant and eat it with impunity. Travelling stock, however, particularly sheep, are often badly affected by it. In New South Wales it has been found that the plant possesses a prussic-acid yielding glucoside, but repeated tests with Queensland material have always given negative results, and the symptoms described by Queensland sheepmen are certainly not those of prussic-acid poisoning. The symptoms are that the head and neck swell to an enormous size, and if the swelling be pierced an amber-coloured fluid runs out. The skin shrivels and the face of the sheep looks as if it had been badly burned, but its life is generally saved. There is no cure definitely known for the after effects of eating the plant.

Daisy Burr.

H.H.W. (Gladstone)—

The specimen is Daisy Burr, *Calotis scapigera*, a plant with a fairly wide distribution in Queensland, but most abundant on the Darling Downs. It has probably been introduced into your district with travelling stock, most probably sheep. The plant has possibilities of becoming a bad weed, and as the patch is only small it would be best destroyed by hand-cutting, raking together, and burning; or if you prefer you can give it a covering of strong salt, such as waste butcher's salt. This should be applied in dry weather, and the first heavy rains would probably wash it out of the ground.

Balsam Pear.

H.A.J. (Maryborough)—

The specimen is *Momordica cherantia*, a plant of the Cucumber family, sometimes known as the Balsam Pear. It is a native of tropical Asia and Africa, and is much cultivated in warm countries as an ornamental vine. One sometimes sees this plant about Chinese gardens, and many Chinese eat the red pulpy stuff surrounding the seeds and eat the fruit boiled, generally before it is ripe. The Indians also use it a good deal in their curries. We have had no experience of the fruit ourselves as we are rather chary of these Cucurbitaceous plants, but we think, in this case, the fruit has to be soaked in water for some time before cooking to rid it of a somewhat bitter flavour. If you want to try it our advice is to cook and taste it discreetly.

White Millet.

R.S.McK. (Mungallala)—

The specimen is *Echinochloa colona*, a native grass with a very wide distribution over the warmer regions of the world. It is sometimes called White Millet, and is very closely allied to such well-known cultivated fodders as Japanese Millet and White Panicum. It is an excellent fodder grass and worth encouraging. The type of country you describe it as growing in is rather unusual for, as a rule, the grass prefers rather a damp situation, though it is not confined to such. It may often be seen as a weed in cultivation round cultivation headlands, &c.—in fact, anywhere where the ground has been disturbed.

Rattlepods.

J.M.N. (Caboolture)—

The specimen is obviously a legume, but bore neither flowers nor pods. It is a stranger to us, but we think it is *Crotalaria acicularis*, a species of Rattlepod, a very common weed in Java and the Philippine Islands. You have probably introduced it accidentally with some of your recent collections. Rattlepods are rather dangerous plants, as several of them, both in Australia and abroad, have been definitely proved by feeding tests to be poisonous to stock. So far as we have observed, however, stock generally avoid them. We would like a specimen with flowers and pods to verify the determination.

Green Cestrum, a Poisonous Plant.

R.C.B. (Chinchilla)—

Cestrum parqui, the Green Cestrum. A very poisonous plant which has been responsible for a good deal of trouble in parts of Queensland. It is not a native, but has either become accidentally introduced or is a stray from garden culture. It is a native of Chili and the Argentine, South America.

Creeping Salt Bush.

A.G. (Springsure)—

The specimen is *Atriplex semibaccata*, the Creeping Salt Bush, also frequently known as Salt Weed. It is one of the most valuable and palatable of the Salt Bushes and worthy of every encouragement. It grows naturally in parts of New South Wales and Queensland, in this State being most abundant, we think, in the Western Downs and Maranoa districts, but we have not had specimens from the neighbourhood of Rolleston before.

Weed in Oat Field—Scented Top.

G. (Hivesville, via Murgon)—

The heavy seed grass, a weed in Oats, is *Lolium temulentum*, a Darnel. This is an annual species of *Lolium* occurring mostly as a farm weed, and has very little value as a fodder. It is eaten in its young stages, but soon becomes unpalatable. The seeds are poisonous, but so far we have never come across any cases of stock-poisoning by them in Queensland, though it is a moderately common weed, particularly on the Darling Downs.

The grass with the light seed head is *Capillipedium parviflorum*, sometimes called Scented Top, owing to the peculiar scent of the seed heads when crushed. This grass is quite common in much of the forest country in coastal and sub-coastal Queensland, and is quite a good fodder. It is closely allied to the Blue Grasses.

Grasses Identified.

J.C. (Kilston, N.Q.).

Arundinella setosa, a grass fairly common in the forest country of Queensland, but of only secondary value as a fodder. We have not heard a local name applied to it.

Eragrostis elongata, Love Grass, is a name applied to several species of the genus *Eragrostis*. They are quite good grasses in the average native mixed pasture.

Heteropogon contortus, Spear Grass. Although the spears of this grass are very troublesome, particularly to sheep, nevertheless, especially in the young stages, it seems to be readily eaten by stock, and when mixed with more palatable food we have known it to make quite good chop-chop or chaff for horses and other stock.

Eriachne sp. There are several species of the genus Eriachne in Queensland. We have not heard a local name applied to the particular one you send.

Chloris ruderalis, a species of Star Grass, closely allied to the common Rhodes Grass (*Chloris Gayana*).

Polycarpæa spirostyles. This plant is commonly known as Copper Plant, for it is supposed to be an indication of copper. It is not a grass, but belongs to the family *Caryophyllaceæ*, which contains the Carnation, Dianthus, and some other common garden flowers.

In sending specimens for determination the usual practice is to number each specimen and retain a duplicate similarly numbered, when names corresponding to numbers will be forwarded.

Tape Vine.

W.D.C. (Wamuran)—

The specimen of vine is *Stephania hernandiæfolia*, known by the rather misleading name of Tape Vine. This vine has been repeatedly received at the Department of Agriculture and Stock as one suspected of being poisonous, and a number of years ago the late Dr. T. L. Bancroft found the roots to contain an exceedingly poisonous alkaloid which has since been found to extend to all parts of the plant. The plant is a very common climber on the edge of scrubs, and as it often creeps among grass, especially between rocks and stones, it is frequently eaten by stock, particularly cattle, with fatal results.

Lemon Grass.

J.M.F. (Dimbulah)—

The specimen is *Elionurus citreus*, commonly known as Lemon Grass. It is fairly abundant in parts of North Queensland and extends as far south as Moreton Bay, though it is comparatively rare in the more Southern parts of the State. It is unpalatable to stock, no doubt on account of its very markedly citron or lemon odour. The grass could probably be made more attractive to horses by mixing it with some other fodder that would mask the peculiar lemon flavour, though even then we are rather inclined to think that the horses would nose the Lemon Grass out of the way as far as possible. If you have a big stock of this grass and do not want to waste it, you would be well advised to try your mixture on a small scale instead of spoiling a lot of otherwise good fodder by mixing it with the Lemon Grass.

Japanese Clover.

G.W.C. (Kybong, via Gympie)—

The specimen of Japanese Clover (*Lespedeza striata*) has come safely to hand. We have had a great number of specimens of this plant from the North Coast, but more especially from the neighbourhood of Kilcoy and Woodford. Some residents claim that it has been there for years, but this is the first year we have noticed it; and it seems to be spreading to a very great extent. It is undoubtedly a valuable fodder plant and cattle seem fond of it, but it has the disadvantage of being a summer-growing legume and is inclined to smother out the grass. That has been the experience in some localities this season, but of course in more normal ones the plant may not be so vigorous.

Grasses—Crow Foot, Summer, Johnston.

L.B.S.R. (Mirriwinni, N.Q.)—

(1) Star Grass, *Eleusine indica*, Crow Foot Grass. This species is widely spread over the warmer regions of the world, and is mostly found as a weed of cultivation and waste places. It is quite palatable to stock, but contains a prussic-acid-yielding glucoside. Stock should be pastured on it, therefore, with a certain amount of care.

(2) Summer Grass, *Digitaria marginata*, a grass widely spread over the warmer regions of the world. Like the Crow Foot, it mostly occurs as a weed of cultivation rather than as a grass of the general pasture. It is quite a palatable grass, but dies off on the approach of the winter months.

(3) Johnston Grass or Johnston River Grass, *Paspalum conjugatum*, a common tropical grass. In parts of the Atherton Tableland it is known as "Sour Grass" or "Yellow Grass," and is said to ruin the common paspalum pastures and to have very little value either as a stockraising or dairying grass. The grass is very common as a cover in coconut and rubber plantations in New Guinea, and in such places we have seen working mules do quite well on it when it was almost their sole fodder.

Ferns and Crotons.

Mrs. P. (Eight-mile Plains)—The two specimens are—

(1) *Adiantum Whitei*, Maidenhair. Described since the publication of the lithograms.

(2) *Doodia caudata*. In "Ferns of Queensland," this species is recorded as a variety of a larger species, namely *Doodia aspera*, but has now been recorded as quite a distinct plant.

The plants mentioned by you as Climbing Maidenhair, Rock Fern, Hare's Foot, Elk-horns, Stag-horns, &c., are all true ferns.

Crotons are very easily struck from cuttings, but the time you will be receiving them (July) will be about the worst time of the year to do this work. We have grown a number of crotons and have been successful in striking them as late as the beginning of the first week in April, but this all depends on the weather. They really strike best from November to early January, requiring plenty of heat for root development. They strike well in either light sandy soil or in soil in which there is a fair percentage of gravelly creek sand. We have also been successful by using a fair proportion of furnace or boiler clinkers in the soil. If you try to strike them about July, you will have some difficulty without heat, although if you have a well protected sunny place, particularly if you have a little glass, you should be successful.

Barley Grass or Native Millet.

F.B. (Brisbane)—

The specimen of grass is *Panicum decompositum*, commonly known in Western Queensland as Barley Grass or Native Millet, although both these names, like many other local ones in Western Queensland, are rather loosely applied to a number of grasses. This particular *Panicum* is generally regarded as an exceptionally good fodder, relished by stock, and nutritious. So far as we have observed, however, it seems to grow best in damp situations, or in a particularly good season.

Grasses Identified.

W.D. (Goondiwindi)—Your specimens have been determined as follows:—

(1) *Astrebla lappacea*, Curly Mitchell Grass. This is the commonest species of Mitchell Grass in Queensland, and I think the best.

(2) *Astrebla elymoides*, commonly known as Weeping or Hoop Mitchell.

(3) *Thellungia advena*. I was very glad to get the local name "Coolibar" for this, also notes on its fodder value. It is certainly anything but a tempting looking grass, though stockowners elsewhere have told me that it is quite good feed. This grass is very common in Queensland and New South Wales, but in the past was confused with another species, the Rat's Tail Grass (*Sporobolus elongatus*). It was first named in comparatively recent years from specimens found growing in a woollen mill dump in Switzerland, and its native country was not known.

(4) *Dichanthium sericeum*.

(5) *Iseilema actinostachys*, Flinders Grass.

(6) *Panicum prolutum*. In New South Wales this grass is generally known as Coolah Grass.

(7) *Chloris ventricosa*, a species of Star Grass.

(8) *Eriochloa* sp., sometimes called Early Spring Grass. These grasses are all relished by stock. The genus is under revision at the present time at the Royal Botanic Gardens, Kew, therefore we cannot give you the specific name for it.

(9) *Chloris acicularis*.

S.L. (Tingoora)—

(1) *Chloris divaricata*, a species of Star Grass.

(2) *Sorghum leiocladium*, a native Sorghum.

(3) *Stipa setacea*, a species of Spear Grass.

(4) *Dichanthium sericeum*, Blue Grass. Generally regarded as one of the best of the native grasses.

(5) *Chloris ventricosa*, a species of Star Grass.

(6) *Themeda australis*, Kangaroo Grass. A valuable native grass, though it tends to disappear under heavy stocking.

(7) A mixture of *Panicum queenslandicum* and *Poa cæspitosa* var. *australis*.

(8) *Poa cæspitosa* var. *australis*.

(9) *Amphilophis decipiens*, Bitter or Pitted Blue Grass, generally regarded as a very inferior grass. Unfortunately, owing to the eating out of the better species in many native pastures, it has become quite dominant.

(10) *Eriochloa* sp., sometimes called Early Spring Grass. Quite a good fodder.

(11) *Poa* sp. Could you send complete material of the grass, including roots?

(12) *Eragrostis cilianensis*, Stink Grass. A rather ornamental grass, but so far as I have observed left untouched by stock. I have heard on good authority on one occasion, however, that horses took very readily to it.

Pigweeds.

D. (Townsville)—

The specimens have been determined as follows:—The small red Pigweed, *Portulacca digyna;* the larger and more upright Pigweed, *Portulacca filifolia*.

The Pigweeds are very abundant plants scattered over the warmer regions of the world. The two particular ones forwarded from near Boulia are both natives of Western Queensland and the Northern Territory. They are not known to be poisonous or harmful in any way, and the family as a whole is regarded as quite a wholesome one. Many of the Pigweeds, both in Australia and abroad, are eaten either cooked or raw as a vegetable. Like other fleshy plants, of course, they will cause hoven or bloat in stock, particularly hungry stock that are pastured on them on an empty stomach. Deaths may ensue, but this is more mechanical than toxic.

Caustic Creeper.

H.M.T. (Lochnagar)—

The Caustic Creeper, *Euphorbia Drummondii*, is looked on as a very poisonous plant both in Queensland and New South Wales. Examination of the New South Wales samples has repeatedly given positive results for the presence of a prussic-acid yielding glucoside, but examination of Queensland plants has always given negative or, at least, doubtful results.

The symptoms of Euphorbia poisoning as given by experienced stockmen in Queensland are certainly not those of prussic-acid poisoning. Prussic-acid poisoning is extremely rapid and, generally speaking, there are no outward symptoms. The chief characteristic of affected animals as observed in Queensland is a swelling of the neck and head. If this swelling is pierced an amber-coloured fluid exudes and the life of the sheep may be saved, though the face and head have the appearance of having been badly scorched.

The Caustic Creeper has a very wide range in Australia, proceeding in through Central Australia to parts of Western Australia, and in the last-mentioned State, Dr. D. A. Herbert, when Government Botanist there, carried out feeding tests on rats and produced the characteristic swelling symptoms recorded by experienced stockmen in larger animals here. Regarding the periods of toxicity of the plant, little on this point is known; but if the prussic acid yielding glucoside is present the plant would probably be at its worst in the first cold weather after late summer rains. Regarding its growth, it is most abundant in the summer months but lasts right through the winter, and I have frequently seen plants growing in August and September.

Queensland Wattle in France.

L.P.H. (Brisbane)—

The common Wattle cultivated in the South of France for the English and Continental cut-flower trade is mostly *Acacia Baileyana*. This particular species, though it commemorates F. M. Bailey, is not grown to any extent in Queensland, except in the colder parts of the State about Warwick and the Granite Belt. In the Continental and English trade it is almost universally known as Mimosa. All the acacias, of course, are wattles, and the genus is very closely allied to the tree Mimosa botanically. According to an article in the "Gardeners' Chronicle" a couple of years ago, *Acacia podalyriæfolia*, our common Silver Wattle of Queensland, had been introduced to the South of France, and limited supplies of it were finding their way to London. The common Golden Wattle of the Brisbane district is *Acacia fimbriata*. So far as we know this last species is not cultivated in Southern Europe.

A limited number of copies of F. M. Bailey's important work entitled "Lithograms of Queensland Ferns," containing 191 illustrations, is available for purchase at this office. The price is 3s. a copy, postage paid.

General Notes.

Staff Changes and Appointments.

Mr. James Purcell (Toowoomba) has been appointed Chairman of the Dairy Products Stabilisation Board until the 7th February, 1935.

Constable W. J. Huey (Millaa Millaa) has been appointed also an Inspector under the Slaughtering Act.

Constable W. Robinson, Officer in Charge of Police at Nebo, has been appointed also an Inspector under the Brands Acts.

Mr. J. R. Canty, Slaughtering Inspector at Innisfail, has been appointed an Inspector under the Apiaries Act.

Mr. M. A. Hannigan (Kyoomba, via Stanthorpe) has been appointed an Inspector on probation under "*The Diseases in Plants Acts, 1929 to 1930,*" and Agent under "*The Banana Industry Protection Act of 1929,*" Department of Agriculture and Stock.

Messrs F. C. Jorss, R. J. Rollston, and N. Lambert have been appointed Assistant Inspecting Cane Testers for the 1934 Sugar Season, and will be stationed at Cairns, Mackay, and Bundaberg, respectively.

Mr. I. H. Simon, Customs Officer, Maryborough, has been appointed an Inspector under the Diseases in Plants Acts, and the Apiaries Act.

The Honey Board.

An Order in Council issued under the Primary Producers' Organisation and Marketing Acts formally extends the operations of the Honey Board for the period from 9th March, 1934, until 8th March, 1939. Notice of intention to make this Order in Council was issued in January last, and a petition for a ballot on the question of the continuance or otherwise of the Pool was invited from growers, such to be lodged before 5th February last. A petition was received, and a ballot conducted, which favoured the continuance of the Pool.

Regulations have been approved under the Primary Producers' Organisation and Marketing Acts, empowering the Honey Board to levy on growers of honey and beeswax at the rate of 1½ per cent. on all honey and beeswax sold during the period from 1st April, 1934, to the 31st March, 1936, to provide for the administrative expenses of the Board. The amount of the levy shall be deducted from the proceeds of sales of honey and beeswax by agents and persons who purchase honey and beeswax from a grower, or sells these commodities on account of a grower, and the amount collected shall be forwarded to the secretary of the Honey Board not later than the seventh of the month next succeeding such purchase or sale.

On the 22nd August, 1929, approval was given for the exemptions of sales of honey by beekeepers direct to local consumers or to retail vendors in such beekeepers' district, subject to certain conditions. This action was taken pursuant to the provisions of Section 15 (4) of the Primary Producers' Organisation and Marketing Acts, which provides that the Board may in such cases and in such terms and conditions as may be prescribed by the Minister, exempt certain growers and certain of the commodity subject to the Act. The Honey Board has requested that this notice be cancelled, and approval has accordingly been given to the cancellation of the notice in question.

Honey—Places of Entry.

In pursuance of the provisions of Regulation No. 1 of the Regulations under the Apiaries Act, the Minister for Agriculture and Stock (Hon. Frank W. Bulcock) has named Innisfail and Clapham Junction as places of entry for the introduction into Queensland of bees, honey, and beekeeper's appliances.

"A B C of Queensland and Australian Statistics."

A copy of the 1934 issue of the "A B C of Queensland and Australian Statistics" has been forwarded to us by the Registrar-General (Mr. G. Porter).

This useful booklet is to all intents and purposes the Official Year Book of Queensland, and is presented under the authority of the State Government. The 1934 edition contains, in addition to the main features appearing in the 1933 issue, information relating to—(*a*) The results of sales held at the Brisbane Wool Market for the last ten years, and (*b*) the disposals of butter and cheese made in Queensland for the last five years.

The rates of taxation in Queensland and other States have been revised in accordance with amending legislation; the main points of the Main Roads Regulations and the Heavy Vehicle Regulations are revised, and points of "*The State Transport Act of* 1932" have been included.

Populations have been revised in accordance with the Census of 30th June, 1933, and per capita figures on ten-yearly tables, &c., have been adjusted.

Information concerning many phases of Production—Primary and Secondary—Finance, Labour, and Industrial matters, Vital Statistics, &c., is included.

Population.—The population of Queensland at the Census date, 30th June, 1933, was 947,789, and at the 31st December, 1933, 949,286.

Queensland's crude birth rate of 18.56 per thousand of population is the second highest in Australia, whilst the crude death rate—8.35 per thousand—was the second lowest in Australia and third lowest in the world. Only New Zealand and South Australia record lower rates of infant mortality.

Trade.—The value of Imports for 1932-33 in Australian Currency was £5,660,772, and the Exports £15,279,726, the excess of Exports being £9,618,954. The Imports and Exports per head of population were £6 0s. 4d. and £16 4s. 10d. respectively.

Finance.—The Public Debt of Queensland at 30th June, 1933, was £114,530,855 —£120 16s. 10d. per capita of population. The total amount of Taxation per capita was £6 0s. 4d., New South Wales and the Commonwealth Taxation being higher.

Motor and Wireless Licenses.—At the 31st December, 1933, there were 91,435 Motor Vehicles registered, and 40,771 Wireless Listeners' Licenses were in force.

Unemployment.—For the last quarter of 1933 Queensland's percentage of unemployment—13.8—was well below that of any other State; the figure for the Commonwealth was 23.0.

Livestock.—At 1st January, 1933, there were 5,535,065 Cattle, 21,312,865 Sheep, 452,486 Horses, and 213,249 Pigs.

The Wool production of 1932-33 amounted to 185,833,546 lb. (greasy), and was valued at £6,976,501.

Agriculture and Dairying.—In 1932 the Wheat Crop amounted to 2,493,902 bushels; Maize, 1,653,853 bushels; Sugar made, 514,027 tons; Cotton (unginned), 6,270,116 lb.; Tobacco, 2,303,861 lb.; the Butter made amounted to 96,317,201 lb.

Mineral Production.—The total Mineral production was valued at £1,784,499 for 1932, including Coal, £684,555; Lead, £573,813; Silver, £182,733; and Copper, £108,858.

Value of Production.—The recorded production from all Queensland Industries in 1932-33 was valued at £47,056,142, or £50 1s. 10d. per capita of population, Primary providing £35 1s. 7d. per capita, and Manufacturing £15 0s. 3d.

These are but a few of the interesting features of the "A B C" which is now available at a nominal cost of 2s. (posted 2s. 3d.). Copies may be had upon application at the Registrar-General's Office, Treasury Buildings, Brisbane.

Regulation under Sugar Experiment Stations Acts.

A regulation under the Sugar Experiment Stations Acts has been issued which provides that the Secretary of a Cane Pest Board shall maintain at his office a register of all transactions relative to moneys due to the Board in respect of fumigants or labour supplied by the Board for the suppression of cane pests. Such register shall be open for inspection upon the payment of one shilling.

It will now be possible for any interested person to learn from the Local Cane Pest Board whether that Board had a first charge over the assets of any particular cane farmer in respect in fumigants, &c., supplied.

Rural Topics.

Chilled Beef—Opportunity for Farmers.

The recent meeting in Sydney of beef exporters and shipping representatives suggests that definite progress is being made towards the establishment, on something more than an experimental footing, of a chilled beef trade with Britain.

Technical research and actual experience both suggest that the successful establishment of the trade in New South Wales is now largely a matter of organisation. Progress will depend, however, upon the active co-operation of all those directly interested. Recognising this, exporters and shipowners have taken the initiative, and it now devolves upon the producers as a body to follow the lead thus given them.

It has been stated, in quarters not lightly to be disregarded, that a successful chilled beef trade will be impossible until a constant supply is available of cattle bred and grown to meet the special requirements of the trade. Eventually, this will become true, but meantime, fortunately for the industry, there is authority, no less trustworthy, for the definite statement that here are now in Australia ample supplies of suitable stock to warrant the commencement of commercial exports as soon as the necessary meatworks and shipping arrangements can be made. In the early stages, large shipments, even if possible, would be unwise. A demand for Australian chilled beef must first be cultivated. And, by the time an extensive demand has been created, the producers will have had an opportunity to prepare to meet it.

Since the South Americans established their practical monopoly of the most valuable section of the British market—the household supply—consumers' requirement have changed radically. Large, fat joints, such as come from big bullocks five years old and upwards, are no longer acceptable to the British housewife, who demands young beef of prime quality. The South Americans have not only met, they have actively encouraged this change in taste, because it still further increased the advantages given them by the chilling process. Australian producers, on the other hand, have not been able to keep fully abreast of these changes for the good reason that, while they remained dependent upon hard freezing, to do so was impossible economically, if not technically.

These and other barriers to progress are now, however, about to be removed, and with the help of Australia's natural advantages as a beef-producing country—and of the Ottawa meat agreements—it will be possible to meet the foreigner on level terms and beat him at his own game. To achieve this, extensive reorganisation of the methods of production will be necessary. The higher comparative prices which may confidently be expected for a higher grade product will, however, justify a considerable degree of specialisation, such as is practised in South America, and the breeding, growing, and fattening of beef for export, either as separate, specialised branches, or in combination, will again become profitable.

To secure the fullest measure of success, the producers must be guided by three principal aims: The breeding of early maturing stock of best beef type; the development of a system of feeding which will ensure unchecked progress and bring the beast to killing condition carrying a high degree of finish at between two years and three years of age, and last, but not least, continuity of supply. The first of these objectives requires no comment. Once breeders are assured of a return on their outlay in raising the standard of their herds they can be trusted not to "let the grass grow under their feet." The third objective, especially in this country, is so intimately identified with the second that separate consideration is unnecessary.

It is upon the second objective—the development of a scientific system of feeding—that the eventual success or failure of the industry depends. To attain it a great deal of work will be necessary, but in the process large numbers of farmers will find an opportunity to employ profitably suitable land at present too valuable for grazing, and otherwise not fully productive. Any successful system of feeding cattle intended for chilling will require the provision of improved natural or introduced pasturage, and, in most cases, of suitable fodder crops. Fodder conservation will also play an important part in the system, which must ensure throughout the year adequate supplies of feeding constituting a "balanced ration" designed for beef production. This is work which, in many cases, the man occupying a small area of good land in a district with a good rainfall will be able to undertake more effectively and more economically than the big grazier.

Details will vary in different States, and even in different districts, because of climatic and other factors, but, broadly speaking, these are the basic principles upon which the successful beef raising of the future must be founded. They are well within the capacity of the enterprising grazier and farmer to attain. The rewards they promise are sufficiently attractive to justify immediate action, so that the production of beef of the best possible quality may proceed progressively and contemporaneously with the exploitation of the chilling process and the cultivation of a market demand for beef "produced in Australia."—L.G.A., in the "Sydney Morning Herald."

Horse-breeding—The Choice of a Sire.

In the breeding of horses there is nothing more important than care in the choice of the sire. A definite ideal must be in the breeder's mind in relation to type. Pedigree is an essential, and purity of lineage cannot be too strictly insisted upon. The next inquiry must be for a sire possessing freedom from hereditary disease determined as the result of an examination by a veterinary surgeon. The main object of the breeder is to secure strength, and at the same time the staying power that enables a horse to do a hard day's work for a lengthened period.

The sire must be active, intelligent, and tractable, though full of determination. Beyond all dispute the best evidence of a horse's staying power and length of service in the heavy breeds is balanced action—the movement and stride that enables a horse to cover the most ground with a maximum of ease and a minimum of friction and wear. True action has a special value in both sire and mare, for where the feet are raised and placed in precise and regular form in walking and trotting, there is resistance to bone and joint troubles, and there is also lengthened service. An evenly balanced body would lose its value on ill-shaped feet, or abnormally dropped legs.

Constitution and stamina are also needed to withstand the stress of continuous work. The indications of a general nature must include a good barrel or middle piece, showing ample space for digestion, and vigorous heart and lung action. A slack-loined horse is more or less "soft," and a tucked-up barrel, sometimes termed "herring-gutted," also betokens lack of stamina. Ample girth, depth through the lines, and fulness at the flank all favour constitution.

It is not an uncommon thing to see a "washy" horse which is big in the barrel, but which with stress of work soon falls away in condition and exposes his true type with a lightness about the girth and loin. A fleshy heavy head should not be favoured; while, on the other hand, a lean head, wide in the cheek, with a good space between the branches of the lower jaw, denotes constitution, as also does the bright, lively eye and quickly-moving forward ears.

Weight and substance with a good top and quality of feather are required. The condition of the skin must be closely examined.

A good temper and kind disposition invariably accompany intelligence and good manners.

An examination of the legs, for durability, must not be overlooked, and should result in the discovery of clean, flat bone, with tendons distinct, free and clear from the bone. Sloping pasterns of medium length are desirable. The closest scrutiny should be made of the structure of the foot—a firm wide heel, strong horny crust, healthy frog, and level placing must be shown.

A general overhaul of the animal in the actions of walking and trotting affords the opportunity of estimating his character, and many features that it is impossible to outline also aid in arriving at fairly sound conclusions. A prominent breeder states that "we should not select as a result of the animals possessing some specially good quality, but rather select him from the absence of faults and the general accumulation of harmonious and worthy qualities in disposition, conformation, and stamina." The exaggerated development of any single meritorious point is not compensation for some flagrant deficiency.

Performances or exhibition in the show ring do not always afford the most reliable evidence of a sire's capacity for leaving sound stock, but these, in conjunction with the proved excellence of his stock, are the best guarantees to owners of mares. The knowledge of pedigree, stoutness, prepotency, quality, weight, action, and other desirable qualifications is thus eclipsed in guiding the breeder by absolute evidence of the very best kind.—A. and P. Notes, N.S.W. Department of Agriculture.

Protein for Milk Production.

In his report on the competition recently conducted by Camden Haven branch in regard to feeding cows for production, Mr. E. O. Dalgleish, Senior Dairy Instructor, emphasised the value of protein.

The protein or nitrogenous portion of any fodder mixture is the most expensive one to provide, but it has been very truly said that the secret of milk production lies in the provision of a plentiful supply of protein. Common fodders rich in protein are lucerne, cowpeas, and vetches, and among the concentrated fodders, linseed meal.

"Balancing" a ration means that the foods are to be mixed in such a way that all the constituents thereof can be most economically made use of by the cow. For instance, saccaline contains a large proportion of carbohydrates—sugar. If fed on a ration of saccaline only, the cow will use only such proportion of the carbohydrates as she requires, and the remainder is wasted. To "balance" the carbohydrates, a fodder containing more protein should be mixed with the saccaline, and the quantity of the latter reduced. A suitable fodder would be lucerne hay. Substitutes, however, could be cowpeas, vetches, red and berseem clovers. A crop which is very high in protein and which has not been tried in New South Wales to any extent is the soya bean, a crop which is grown very extensively in the United States.

The cow's natural fodder, and one which naturally provides a balanced ration, is a mixture of grasses and clovers in bloom, and if this could be provided for her all the year round would be easily the most economical method of feeding. A start in the right direction is the provision on most of the farms of areas of winter grasses and clovers. If continued and extended into a number of small paddocks on each farm these will be of incalculable benefit in time to come, when it may be possible for paspalum and clover pastures to provide grazing in the summer, with rye and clover pastures for the winter—reserves in case of necessity being provided by the pit silo.

A Useful Lick for Dairy Cattle.

Where the dairy farmer has reason to suppose that his cows are suffering from a mineral deficiency in their diet, commonly indicated by the habit of bone-chewing, he should lose no time in correcting the condition. In the case of hand-fed cows, the addition of two or three tablespoonsful of sterilised bone-meal to the feed daily will be found highly beneficial. Where the cattle are not hand-fed, a lick should be provided in troughs in the paddocks or in boxes in the milking sheds or feed stalls. This lick may be simply sterilised bone-meal itself, or if it is desired to provide the animals with other ingredients as well, including salt, the following mixture will be found of value:—

Salt	40 parts.
Sulphate of iron	1 part.
Bone-meal	10-40 parts according to the requirements of the cattle.

Soil Erosion.—A Cause of Enormous Loss.

From every conceivable angle erosion is a devastating agency. It is the greatest thief of soil fertility. It steals not only the plantfood contained in the soil, but the whole body of the soil, plantfood and all. When this productive material that required centuries in the building is washed out of fields it cannot be economically hauled back, even where it is washed no farther than from the upper to the lower slopes of fields. That which passes down into the beds of streams and on out to the ocean is lost as irretrievably as if consumed by fire. It has been estimated that erosion steals twenty-one times as much plantfood as crops take out of the land.

Surveys and soil-loss measurements indicate that at least 3,000,000,000 tons of soil are washed out of the fields and pastures of the United States every year. The value of the plantfood contained in this amounts to more than two billion dollars, on the basis of the cheapest fertilizers. Of this almost inconceivable wastage, the direct loss to the farmers of the United States of America is not less than 400,000,000 dollars every year. This is paid for in reduced acreage yields, increased cost of cultivation, fertilization, and the growing of crops for the sole purpose of building up impoverished fields, in land abandoned, highways damaged, reservoirs, irrigation ditches, and culverts choked with erosional debris, and accumulative thinning of the surface soil, the staggering cost of which is postponed until the last inch of soil is washed off.

Pig Raising.—Suitable Crops and Feeds.

Lucerne, either for grazing or for cutting and feeding in the sty, is the best green feed for the boar, sows, and young pigs. Wheat, oats, rye, and broadcast maize are also very suitable as green feeds for grazing; climbing varieties of cowpeas can be sown among the maize.

Sorghum should be fed only when mature. Rape is a fine winter crop, ranking next to lucerne for grazing purposes. Jerusalem artichokes are very hardy, and grow well in light soils. The pigs should be turned in to harvest these after the plants have flowered.

Sweet potatoes, suitable for warm districts of good rainfall, are good for pigs when fed with a small percentage of maize or other grains and skim-milk; they are utilised in the same manner as artichokes for grazing. Sugar beet and mangolds are excellent feed fed raw, and can be readily stored in a pit. Potatoes should be boiled and fed with skim-milk or maize; the water in which the potatoes have been boiled should not be given to the pigs.

Pumpkins can be largely grown; they should be fed raw. Wheat and barley should be crushed and steamed for a few hours and fed with skim-milk or whey.

With regard to mill refuse (pollard, bran, and sweepings), the market value of these determines whether it pays to feed on them or not, but a very little pollard mixed in milk keeps pigs growing and fattening well. Bran, which is properly rather a laxative than a pig food, is very useful for brood sows. Sweepings from mills, &c., should be used carefully, as they often contain a lot of rubbish. It is wise to soak the sweepings, so that any nails, nuts off bolts, or similar dangerous foreign objects may sink and be separated.

Skim-milk, butter-milk, and whey are widely used as food for pigs. Skim-milk, which should be fed with crushed grains or pollard, is a good flesh-producing food. It should not be used straight from the separator, but allowed to stand an hour or so, so that the gas may work out of it. When feeding butter-milk, always add pollard or crushed wheat, barley, or maize; otherwise the pigs will be soft and blubbery when dressed. Whey also should only be fed when mixed with crushed grains.

To avoid any chance of tuberculosis, all milk products should be boiled before being fed to the pigs.

Following is a table of crops (mostly green feeds) suitable to grow as food for pigs:—

PLANTING TABLE OF CROPS SUITABLE FOR THE PIG-RAISER.

Crop.	When to Sow.	When Available.
Barley	February to April	May to October
Rye	ditto	June to September
Oats	ditto	June to November
Rape	ditto	June to September
Kale	ditto	August to October
Cowpeas	September to November	January to April
Pumpkins	ditto	January to June
Maize	October to December	January to April
Feed Millets	ditto	December to April
Sorghum	ditto	December to May
Turnips	February to April	May to October
Artichokes	September to October	March to April
Sweet Potatoes	October to November	February to June
Mangolds—		
Autumn	March to April	September to December
Spring	October to November	May to July
Potatoes—		
Autumn	February	May to June
Spring	August to October	January to February
Lucerne—		
Autumn	February, March, April	August to May
Spring	September to October	Following year

A. and P. Notes, N.S.W. Dept. of Agric.

Tree-planting Time Approaching.—Preparation of the Ground.

Because their wholesale removal has been necessary in the process of land settlement, trees have come to be regarded by many farmers almost as an excrescence. There are those, however, who appreciate that trees are of considerable importance in agricultural and pastoral economy, as sources of shade and shelter, fuel, fodder, and timber, and that on the score of beauty too they have a claim to their place on the farm. Such farmers may again be reminded that planting-time is now approaching, and that the best results will be obtained if the land is well prepared.

When forestry work is carried out on a big scale it is not possible to prepare the ground for planting as thoroughly as could be desired, and very often the only preparation consists of digging a small hole, or merely inserting the plant in a wedge-shaped notch made by a spade or notching tool. The farmer, on the other hand, has only a small area and a limited number of trees to deal with, and the necessary labour is usually supplied by himself in any spare time. Moreover, he requires quick and certain results, and must therefore ensure the best possible conditions for planting. In general forestry work allowance can be made for a number of failures, but in windbreak planting, for example, a single failure is much more important. Thorough preparation of the soil is therefore necessary.

Where a number of trees are being planted together, such as windbreaks, avenues, or tree lots, the land should be first ploughed. New land should be broken up before winter and allowed to lie until planting time. A plan which has its advantages is to make the first ploughing only deep enough to cover the grass and herbage. Shortly before planting the ground should be cross ploughed deeply, and then harrowed. Ground previously under crops will probably contain many weed seeds, and to enable the young trees to become established before the weed growth becomes unduly aggressive such land should be ploughed and harrowed, and planted immediately afterwards with the trees. Where hillside planting is being carrried out, the ploughing should follow the contour of the hills as far as possible.

Ordinary hole planting is attended with some risks, especially where the subsoil is impervious. In such cases the hole tends to become merely a pool of stagnant water and a grave for tree life. Where trees must be planted in holes, such as in the case of isolated shade, shelter, and ornamental trees, the holes should be made as large as possible. A hole 3 feet by 3 feet and 2 feet deep is the smallest size allowable, and larger holes, where possible, should be made.

Where deep digging carries the hole into an impervious subsoil, it is better to make the hole wide and shallow, the depth not exceeding that of the soil. On wet, poorly drained soil ridges or mounds may be formed as sites for planting. Ploughing two adjoining furrows so as to throw the sods together achieves this end in a minor way. Irrespective of what method is adopted, the preparation of the land should be completed before stock for planting is obtained.

The best time for planting is when the plant is at its resting period, and when moist, cool conditions prevail. Generally speaking, May to August are the best months. The effects of frosts must be studied, and spring planting is often necessary in some localities, except for deciduous species. Where the rainfall is heavy and conditions generally are cool, the planting period may be considerably extended. A cool, cloudy day and a fairly moist soil provide ideal conditions—A. and P. Notes, N.S.W. Dept. Agriculture.

Lean Bacon in Demand.

Altered demands the world over, and a steadily increasing demand for lean bacon and ham and for fresh pork products carrying a maximum of lean meat are matters with which the pig-raiser needs to become conversant. There is no call nowadays for the thick, heavy fat pork so popular years ago, nor does it pay to attempt to force on consumers the class of bacon for which they have no appetite. In order to obtain a maximum of lean meat it is essential that the pig's rations carry a maximum of flesh forming foods, and for this purpose nothing is better than the by-products of the dairy—skim milk buttermilk, and to a lesser extent whey, with other animal proteins like meat meal used as a supplementary or substitute for flesh formers as well as vegetable proteins in the form of pollard, pea meal, barley meal, and succulent greenfoods. Under Australian conditions the feeding of carbohydrates (fat formers) must be carried out judiciously, otherwise there will be an excess of fat and a minimum of lean meat, instead of vice versa. Whatever the system of feeding, the objective must be lean bacon, otherwise the profits will diminish and the business become unprofitable.

Silos and Silage.

Based on more than ten years' experience of silos, Mr. Alex. Smith, of Bandon Grove, gave an informative address at the recent annual conference of the Upper North Coast District of the Agricultural Bureau of New South Wales. He said:—

My experience with silos and the making and feeding of silage dates from 1922. At that time I had some oats which were not required for feed. I was anxious to try to conserve it in a succulent form. It was only a small piece, such as many coastal dairy farmers have left over in a fair season. The weather at the time made hay-making rather risky. At that time pit silos were not considered advisable on the coast, nor the making of silage in quantities less than 50 tons. I decided that it was worth while to try if these small surpluses of green fodder could be successfully conserved as silage. A pit was excavated, estimated to hold about 20 tons, and filled and covered with soil. It turned out well, and the cows were quite satisfied with it. When this very small pit was filled with maize the produce was not as good as the oat silage, but still the cows appreciated it. I consider crops such as maize or sorghum should be chaffed, as an appreciable amount of the lower end of the stalk remains uneaten. I also think it advisable to give a pit a coating of concrete over netting laid on the bottom and along the sides. Getting silage out of an unroofed and unconcreted pit in damp weather is a messy and slippery job, and a pit that is to be used permanently should have a roof.

Later on we excavated another pit right on the bank of the Chicester River, estimated to hold about 44 tons. About 2 acres of oats and field peas were put in, also half an acre of Italian rye and golden tares, and 3 acres of lucerne. The Italian rye and golden tare mixture made the best silage I have ever seen, and the oats and peas were also good. This pit was later filled with maize, and not touched for four years. Then it was partly fed out, and the remainder used two years later. This pit was under water several times, but it had no detrimental effect.

An overhead concrete silo was built in the summer of 1931-32. The silo cost £94, not charging our own labour.

The cows received 30 lb. silage per day each, and sometimes during the winter nearly 40 lb., but instead of using expensive concentrates the cows had green oats in fine weather and hay in wet weather, and, in spite of the fact that they were used to having concentrates in the winter, the production this last winter was greater than I ever remember, and we saved the expense of the concentrates.

We have now made silage from crops at all stages of growth from before tasselling till nearly hard grain stage, but prefer to make maize silage when the grain is in the milk stage. When made at a later stage it is our experience that the grain passes through the alimentary canal of the cow unused and is, therefore, a dead loss. There is a better distribution of nutriment throughout the whole plant at the milk stage than at any later stage and it is in a more digestible and easier assimilable state.

A few years ago an Englishman at the School of Animal Nutrition, Cambridge, England, got the credit for the discovery that pasture plants in the leafy stage had a far greater feeding value than the same plants after they had started to produce stems and seed heads. I think our own Department of Agriculture should get the credit for this discovery. An article which appeared on page 657 of the "Agriculture Gazette of New South Wales," September, 1919, will bear out what I say. The credit of the discovery belongs to the New South Wales Department of Agriculture; the credit for emphasising it belongs to the Cambridge people. The grassland experts emphasise the importance of making silage from plants in the leafy stage.

The British Ministry of Agriculture recognises four types of silage:—

(1) *Sweet, Dark-brown Silage.*—Made when the material heats up too much and the temperature rises above 113 degrees Fahr. Factors contributing to this are a comparatively dry crop, either one that is dry from being mature, or from being allowed to dry somewhat after being cut. Such dry crops facilitate fermentation, both because they do not pack so tightly and thus allow air to penetrate the silo readily, and because the heat that is generated by fermentation has comparatively less moisture in the silage to heat, and consequently the temperature rises more.

(2) *Acid, Light-brown or Yellow-brown Silage.*—When less air is allowed to intrude than above, and the material does not heat up so much, this type commonly occurs (temperature range 86 to 104 degrees Fahr.). As a rule there is not much juice expressed from the silage when this type is being made. Acid brown silage is commonly made in pit and trench silos. This silage has a yellow-brown colour,

and an acid, though pleasant, smell, largely due to the presence of acetic acid, the yellowish types having the more pleasant smell. It is readily eaten by stock, which thrive upon it, and it is to be recommended. This is the most common form made, and it is much superior to the sweet, dark-brown variety.

(3) *Green "Fruity" Silage.*—Usually this quality is only made by chance, and it is hard to control conditions so as to make it with certainty. It is made by rapidly building fresh lush, leafy grass (temperature about 86 degrees Fahr., but no higher). This type has a green to olive-green colour, and a smell that is delicious —neither sweet nor sour—and is best described as "fresh" and "fruity." It is greedily eaten by stock, and it has recently been shown that its digestibility is very high. It has one disadvantage—much juice is lost.

(4) *Sour Silage.*—Sour silage has generally a dark-brown or olive-brown colour, and a pungent and very unpleasant smell, due largely to the presence of an acid. It is commonly made when a very immature and succulent crop is ensiled. In this case the watery fodder packs downs very closely in the silo and excludes the air to such an extent that little heating is possible. Thus crops of immature maize often give rise to sour silage. Again, sour silage is frequently found at the bottom of trench silos—especially if the material has been carted in wet weather, because the trampling of horse and cart over the trench, as well as the superimposed weight of silage, squeezes out the air and limits fermentation. Such defects may be obviated and the sourness reduced if the making of the silage proceeds slowly so that a certain amount of heating may occur in each layer of 3 or 4 feet before the next layer is put on. This sour silage has a high feeding value, and is quite palatable, despite its unpleasant smell.

In filling the silo, proper consolidation, by trampling, is, of course, important, but no less important is proper distribution. If this is not attended to the lighter and looser material, such as the leaf, is apt to fall in one area and a nest of mould is likely to develop.

Points in Citriculture.

Speaking at the annual conference of the Upper North Coast District of the Agricultural Bureau of New South Wales, Mr. K. D. McGillivray, of Moorland, said:—

I ask you to accept me as your guide on an expedition into the mind of an orchardist, hoping that we may see something of his mental processes and, if our understanding is keen enough, we may even catch a glimpse through his eyes, seeing things as he sees them.

The commercial orchardist's first duty to his trees is to practise a system of cultivation, manuring, and pruning that will ensure soil fertility and will encourage desirable cropping habits. The measure of his success, then, largely depends on his attention to pest control. An orchard pest is a living thing belonging either to the animal or the vegetable kingdom—that interferes with the growth of trees or the production of high-grade fruit. The commercial grower must know how to deal with his pests.

The satisfaction that attends the growing of clean, healthy trees and clear-skinned fruit of good quality should be enough to encourage the non-commercial grower, who grows mainly for home use, to learn something of pest control. The appearance of the trees near his home and the health of his family would be expected to interest him, apart from other considerations.

If there is no appeal to him in these things perhaps he may have a sense of fairness and realise that by attending to pest control he will be getting rid of a centre of infection that may have been making life a burden to a man who is trying to make a living from fruitgrowing. If you have unhealthy trees you do not know how far the pest is spreading. If the home grower of fruit is still indifferent he may find himself in conflict with the Plant Diseases Act. The inspectors appointed under this Act have wide powers, and heavy penalties can be inflicted for neglect to comply with the regulations.

The gradual expansion of commercial citrus-growing on the North Coast makes this subject of special interest, and makes is imperative that owners of farms on which more or less neglected citrus trees are growing should make some effort to clean them up. What would a dairyman do to an orchardist who owned a diseased bull which he allowed to roam the district, or who sold milk and butter not being a registered dairyman? What can an orchardist do to a farmer whose neglected trees are breeding and spreading pests and who is unloading the product on to local markets—some of it good fruit, some inferior—and much of it being sold at prices that show no knowledge of market values? Due largely, perhaps, to the less organised

condition of orchardists, the law cannot give him similar protection to the dairymen. He can have the Act enforced, compelling the control of some pests and the destruction of some trees, but he cannot eliminate unfair competition. The orchardist does not deny the farmer the right to sell his surplus fruit, but he does think that the farmer should at least pay some attention to pest control and should learn something of market values. Grown without cost, any price may seem to be all profit, but that state of affairs cannot last. The commercial orchardist cannot afford to allow it to continue.

Mr. McGillivray had with him a number of diseased and pest-ridden specimens of citrus fruit and foliage, and he described the best measures of control or prevention for the different pests and diseases. Dealing with fruit flies, he said that these pests were well known on the coast—if not in the winged stage, then as grubs in peaches. Fruit flies could be controlled by systematic picking up and destroying of fallen fruit and by the use of traps or foliage poison sprays. They had a sympathetic ally in the loquat tree, the relationship between the two comparing to that existing between the blackberry and the rabbit. The loquat tree provided a breeding place that carried the fly through the winter and gave it an early start in the spring. Unlike most other fruits, loquats did not fall to the ground when infested with the fruit fly maggot and, consequently, the opportunity of burning, boiling, or burying the pest did not present itself.

Mr. McGillivray concluded by urging them not to leave old, unproductive fruit trees of any kind on the farm to die a lingering death, infested with every known pest. Treat useless trees with an axe, was his advice, and apply pest control measures to those that are producing fruit.

Care of Pig Weaners.

Weaning time is a very critical period in the life of a pig. If the young pig has been given feed in addition to what it has received from the mother it should have made a good start and should then be fed, at least twice daily, all that it will eat up clean. The young pigs should have the run of good fresh pasture if possible, and should be fed on crushed grains, pollard, and skim-milk, with lucerne, rape, or barley as green feeds, or pumpkins, mangolds, &c., if possible. All slop feed should be fed while sweet, and should preferably be given warm, after having been steamed for about four hours. The steaming of such grains as are given is attended by better results than merely soaking.

The pigs should have a shallow wallow (preferably of concrete) in which the water is kept as fresh as possible. Wood ashes, cinders, and a piece of rock salt should be available in the yards, which should be provided also with a dry shelter shed and bedding. Too many pigs should not be kept in one yard. When about three to three and a-half months' old any boars that may have been kept should be separated and placed in different small paddocks, where they should be kept until ready for penning prior to marketing as porkers or baconers.

An important point is always to have the pigs graded, so as to keep the same sized animals together, thus preventing large pigs from jostling the smaller ones at the feed trough. Pigs will be found to do much better if a system of grading is in force. Approximately forty pigs can be run to the acre, but the exact number will depend upon the size of the animals and upon the pasture provided.

To Remove Hair from Hides.

Soak the hide in fresh water, if it is a dried one, to which a few handfuls of washing soda have been added, until the hide is quite limp and soft as a fresh hide. Remove all scraps of fat, flesh, &c., and rinse once or twice.

Now put the limp hide in a solution of unslaked lime and water, in the proportion of 2 to 4 oz. of lime to the gallon. Soak for twenty four hours; the hair should then come out. If not, make up a fresh liquid and soak again, when the hair will come away from the skin readily by scraping with a blunt instrument. Give the skin two or three soakings and rinsings to free it from any lime, and then spread out to dry in the shade.

Before the skin is quite dry, rub in a little mutton fat or tallow and work the skin well. It will then be soft and pliable when dry; this will make what is called "greenhide." Omit the fat or tallow if the skin is to be tanned.—"Journal of Agriculture," Western Australia.

Harvesting of Tobacco.

Much of the trouble encountered by the tobacco-grower when selling his tobacco is due to mistakes made at the time of harvesting. It is essential, writes the Tobacco Expert of the Department of Agriculture, that only leaf which is at the right stage of maturity should be picked for treatment by the flue-curing process. No method of curing will rectify harvesting at the wrong stage.

It will be observed that all the leaves on the plant do not ripen at the same time, but that in all cases the leaves start to mature from the bottom upwards. To secure the best results, and obtain an even cure, each leaf should be taken off separately as it reaches maturity. This, briefly, is what is meant by "priming."

The leaves are then placed in baskets or other suitable receptacles and taken straight to the barn to be strung in the shade, care being taken that after "priming" they are kept out of the sun as much as possible.

The leaves are then made up into "hands" containing four leaves each. A 4-feet stick will take about twenty "hands," ten on each side. In each "hand" of four leaves two should face one way and two the other, the middle two having their backs together. When the tobacco is to be flue-cured, the "hands" should not be jammed up close together, but there should be a space of a few inches between each on either side of the stick.

The method of stringing it is somewhat difficult to describe. The stem-butts of each "hand" are strung with a twist of the string, to hold them together. The string, which is about twice as long as the stick, is held fast permanently at one end by being pressed into a slit in the wood, and when the required amount of tobacco has been strung, the loose end of string is run through another split at the other end, and made secure. The grower quickly finds out how it is done, after a trial or two.

Hanging may also be carried out by threading each leaf with a needle and twine through the midrib, but the process is a tedious one. Yet another method is to put fixed wires through the curing stick 7 inches apart and so that they project 5 inches on each side. The leaves can be hung on the wires by piercing through the stem-butts. Leaf so strung is very liable to damage by tearing when the stick is being handled, and it is not possible to bulk down without removing the leaves from the wires.

PLATE 139.
A cotton farmer's home, Theodore, Dawson Valley.

The Home and the Garden.

OUR BABIES.

(Issued by the Queensland Baby Clinics.)

Under this heading a series of short articles by the Medical and Nursing Staffs of the Queensland Baby Clinics, dealing with the care and general welfare of babies, has been planned in the hope of maintaining their health, increasing their happiness, and decreasing the number of avoidable deaths.

THE STORY OF SUGAR IN THE HUMAN BODY.

NOT the least of the marvels revealed by science is that of the activities of sugar in the human body. Sugar is always present in the blood, but in extremely small quantities—very nearly one part in a thousand. Yet if this proportion is lessened the subject loses muscular power, becomes faint and, if the proportion is still less, falls unconscious and speedily dies. For sugar in minute proportion is absolutely necessary to maintain the life of all his tissues, and in its absence the first to fail are the cells of the brain. But the proportion of sugar in the blood in health is strictly limited. Should it rise above two parts in a thousand the excess passes off in the urine. If the proportion persists above this level, he is a sick man. He is suffering from diabetes, a serious and often fatal disease.

Sugar is rapidly absorbed into the blood when taken in food, but the main portion in the blood is derived from starch, which is eaten in the form of bread, potatoes, and other common foods. This starch is slowly converted into sugar during the process of digestion. Sugar, therefore, enters the blood during and after meals, but is always being gradually used up by the living body, or more rapidly by violent muscular exertion, or in the production of heat when the body is exposed to cold. As sugar enters the blood in comparatively large quantities and is being used up, often very slowly, during the intervals, how is its quantity in the blood kept fixed within such narrow limits?

There is a large gland deep in the abdomen known as the sweetbread or pancreas. This secretes a fluid which takes a very important part in the digestion of food. But inside this gland are a number of little islands of a tissue which has quite a different function. They secrete a substance necessary for the continuance of life. This substance has recently been obtained from the pancreas of freshly-killed animals, and to it has been given the name "insulin." It has the marvellous property of converting the excess sugar in the blood into animal starch (glycogen), which is stored up partly in the muscles, but chiefly in the liver, and so rendered harmless. From these stores the sugar necessary is gradually released into the blood as it is needed.

Sugar may Cause Disease.

When the pancreas has been damaged by disease, it is unable to secrete sufficient insulin, and the man suffers from diabetes. By injecting small daily doses of insulin under the skin the excess of sugar in the blood can be prevented, and with very careful treatment the man may continue for many years in good health and capable of active work. He

is not cured of his disease, but its bad effects are prevented. In nearly all cases he has to continue his insulin injections to the end of his life. If he takes too little insulin his diabetes returns; if he takes too much (and it is often difficult to regulate the quantity) he becomes weak and faint, and unless he takes a good dose of sugar (which is strictly forbidden to the diabetic under ordinary circumstances) he may fall unconscious and die.

Use and Abuse of Sugar.

The self-protective powers of a healthy body are wonderfully elastic. They are sufficient against all ordinary contingencies. On a natural diet sugar is taken much diluted in milk, in fruit, or in the juices of some vegetables such as sugar-cane. Starchy foods are slowly digested, and impose no sudden strain on the tissue that secretes insulin. But pure concentrated sugar is an artificial product. Added to other foods in small quantities it is harmless and valuable. Taken in large quantities, its rapid absorption imposes an unnatural strain on the insulin-producing cells of the pancreas. Unless these are in a vigorous and healthy condition, serious harm may result. Diabetes is becoming an increasingly frequent disease among people of the British race.

There are rare conditions in which pure sugar is the best restorative. Among these is the athlete who is "all-in" after excessive muscular strain—the marathon runner, for instance. Some patients with degenerated heart muscle may stave off death for a time by increased sugar consumption; their urgent need justifies the risk. There are a few children who suffer from faint turns from decrease in their blood sugar. The most reasonable explanation is that their "islands" have been so stimulated by eating sweet things that they do not stop secreting insulin even when it is not wanted. These children need careful and prolonged medical supervision and treatment. Whether they are candidates for future diabetes is not yet known, but it is possible.

Sugar is therefore a food capable of causing serious harm when taken in excess. We have not here space to dwell on the serious conditions which have been revealed by the school dentists. It is pitiful to see children spending their pennies in destroying their teeth. Nor can we narrate how the over-eating of sweet and starchy foods has been found to diminish their power of resistance to infections. As a sugar-producing State Queensland has a special interest in these matters, for any attempt to increase the consumption of sugar beyond the limits of health is likely to recoil on the industry.

THE CHILD AT SCHOOL.

How to Care for His Eyes.

Miss Stella Pines, in a recent issue of the "Bureau Record" (Agricultural Bureau of New South Wales), writes:—

IT does not matter whether the child has his own governess, whether he has his lessons by correspondence, or whether he goes to a formal school or not, every day is a school day, for he is learning from example through his environment.

In the public schools, the school medical officer and the school nurse see every child at least once a year, and his defects are listed, and follow-up work is carried out to get the co-operation of the parents in having these defects rectified.

Just as the baby has every right to be given a good inheritance and be cared for in his helplessness, so the child of pre-school and school age needs a good overhauling every year to see that his body, both mentally and physically, is fit for the burden of everyday education, whether it be arithmetic, reading, spelling, or any of the other subjects, or that most precious of subjects, his health.

Because the child is growing, eating, and sleeping he may not be getting the best out of life or making the best use of his mind, for the simple reason that he may have a defect of hearing or his sight may be getting gradually worse, due to nearsightedness or farsightedness, and the harm may not be realised until a decided abnormality becomes apparent.

What can parents far out in the country do in order to know these things?

First of all, if your child does go to school, see that all defects pointed out by the nurse or medical officer are rectified as early as possible. But is quite a long time from his baby helplessness to the school age of five, six, or seven, and much can happen in that time. If, at any time, the bush nurse should visit you or the doctor should be called in for any one member of the family, take this opportunity, when the patient is convalescent, to have the whole family, including father and mother, overhauled, but especially the little run-about, for it was through the defects of children entering school for the first time that it was recognised that physical examination should be a necessary part of the school programme.

So much has been written of the child before he is born and in his first year that we will not spend much time except to give a few details. The younger the child the more easily he will learn good habits, for he will not have the difficult task of breaking bad ones to have them replaced by the good; so begin early and get your child ready for school. The best time to begin is, of course, before he is born, and it is through the mother's health that this is accomplished. His right is to be born healthy, and then to be taught to live healthily. For the first year he is dependent upon his parents, and if he learns good habits during this time, regularity in feeding, sleeping, and elimination, if he is given the right kinds of food at the right time, has plenty of fresh air day and night, is clothed properly, and has sufficient exercise, he has the best foundation for his school life.

When he begins to run about he becomes a social little being, and it is at this time that he begins to poke into everything, becomes a regular little busybody and wants to know the whys and wheres of everything. He still needs to be fed regularly, and all the other rules of health.

Is He Looking at the World the Way He Should?

His eyes are one of his most precious possessions, and defects are frequently overlooked. The child with defective eyesight does not know he does not see well, for he sees as he always does. See if the child looks at you or his toys with both eyes alike, or whether he squints; if he does, the good eye does all the work and the other gets weaker for want of use. Observe if his lids are red, or if there is any watery discharge, if he avoids light, or if he holds things far away or too close. All these things should make you suspicious, and he should see a doctor, not just a man who fits glasses. You can easily test your child out by having him read certain things at different distances and of different sizes, first covering one eye and then the other.

For the school child, observe him when he is doing his lessons. See if he makes frequent mistakes with letters or figures. He may complain that things look blurred, he may again say he has frequent headaches, or that he has pain in his eyes, or he may again hold his books far away or too near. See that he has a good light to read by, especially at night. He should be encouraged to sit where the light comes in over his left shoulder, and he should never be allowed to read out in the sun with the sun striking the book itself. He should not be allowed to read lying down, except in a good light, when he is lying face down as children love to do. A shade should be worn to protect him from any very bright lights, and the light should not shine directly into the eyes.

Because a child has been fitted with glasses this year they will not last him a lifetime, for as he grows his eyesight changes and he needs his glasses adjusted periodically. A poor report from school should always receive the attention of the parents and the cause found for it.

Prevent Accidents.

A few words about preventing accidents to the eyes. Never allow a child to play with sharp-pointed instruments, as they are apt to slip, and the child plays so intently that he is mostly leaning over the objects of his play. Teach him the

right use of scissors, and other pointed things, for many a child has had injury to the eyes through trying to open a bottle or something of the kind with a fork or scissors or knife.

Teach him the right way of playing with fireworks, how to protect their eyes from fire and great heat, very bright glares, and, above all, not to play with explosives and lime. Within twelve months I have come across three children, one completely blind, and the other two with just the faintest glimmer of eyesight, through playing with lime in bottles.

Teach a child who wears glasses how to protect them, and always to walk into a darkened room with his hand before his face so as to protect his glasses.

If at any time one of the family should meet with an accident to the eyes or get a piece of metal in them, move heaven and earth to get him to a doctor.

Mothers far back in the country away from help when a child is born, should see that his eyes are well cleaned at birth. If your doctor or nurse is there they will attend to this, but there are times when there is only a neighbour or perhaps a husband, so have ready some cotton wool and cool, boiled water, and wipe each eye separately from the nose outwards, with separate cotton wool balls, and if one eye should at any time become infested be careful to protect the good one.

Do not wipe a child's eyes with your handkerchief, especially when you have a cold. "Safety first" and "prevention" should be the watchwords of your treatment of your school child.

IN THE FARM KITCHEN.

A Cleanser for Kitchen Use.

Ingredients.—1 cake sand soap; 1 small packet Lux; 1 packet soap powder; ¼ cake of either Sunlight or Lifebuoy soap; 7 cups water.

Method.—Powder sand soap and mix with soap powder and Lux and shave the soap. Boil all together for seven minutes; stir well all the time it is boiling as the sand soap goes to the bottom of the vessel. Take off fire and stir till it cools. Put in tins. This makes a good quantity.

Home-made Soap.

Ingredients.—5 lb. clear fat, free from salt; 1 lb. caustic soda; 8 quarts of rain water; 1 lb. resin, finely crushed; ¼ cup borax; 1 cup of kerosene; 1 small packet of Lux.

Method.—Put all materials into a kerosene tin at the same time, and bring to boiling point. Then simmer for about two or three hours, on side of stove; the mixture should then be of the consistency of honey. Prepare moulds by wetting with cold water, stir well, and turn the mixture into them cover up, and stand for two days. Turn out and cut into bars, put on shelf to dry, and turn occasionally so as to ensure drying evenly.

Caution.—When bringing to the boil, stir frequently and watch closely or the contents will boil over quickly. A good vessel for mould is to cut a kerosene tin lengthways which will make two.

Table Salt.

Take 2 cups common salt, rolled finely. Then add 1 tablespoon cornflour and mix thoroughly.

If liked a little finer add a little more cornflour.

Articles Made from Flour Bags.

Flour bags can be made use of for a number of purposes on the farm.

Four 50-lb. flour bags make a kitchen tablecloth.

One 50-lb. flour bag makes a kitchen apron.

One 25-lb. flour bag makes a child's play apron.

One 25-lb. flour bag makes a pair of rompers.

To remove the letters or printing from the bags, wash newness out, soap well, put in cold water with a handful of washing soda and boil; then rinse well.

Lemon Trifle.

(1) Put water and sugar on to heat. Blend the cornflour with the juice from the lemons and grate the rind from two of the lemons.

(2) Add the grated rind and the blended cornflour to the water and sugar and bring to the boil. Cook gently for two minutes, stirring all the time.

(3) Allow to cool slightly, then add the beaten yolks of eggs. Cook carefully without boiling.

(4) Make a pyramid of sponge cake in a glass dish. Sprinkle some crushed ratafias over it.

(5) Pour the cool lemon mixture over the cake and allow to become quite cool.

(6) Beat the whites of eggs to a stiff froth and fold in four large tablespoons castor sugar. Decorate the trifle with this meringue. Sprinkle with chopped nuts.

Ingredients.—1 quart water; 4 eggs; 4 lemons; 2 tablespoons cornflour; 1 cup sugar.

Lemon Fluff.

(1) Put the milk to heat, then add the blended cornflour and sugar. Bring to the boil and cook three minutes.

(2) Cool slightly, stirring occasionally, and when cool add the juice of two lemons and the whites of eggs, stiffly beaten.

(3) Stir the mixture well. Wet a plain mould and decorate it with the lemon cut in thin slices. Pour in the fluff and when cold turn into a glass dish. Serve with boiled custard made from the yolks.

Ingredients.—1 pint milk; 2 tablespoons cornflour; 3 tablespoons sugar; 3 lemons; whites of 3 eggs.

Orange Delight.

(1) Bring sugar and water to the boil, add the cornflour, blended with the orange juice, and the grated rind of one orange.

(2) Cool a little, then add stiffly beaten whites of eggs and beat rapidly till white and foamy.

(3) Pour into a wet mould and serve with boiled custard.

Ingredients.—1 cup sugar; 2 good tablespoons cornflour; 1 pint water; 2 oranges; whites of 2 eggs.

Lemon Meringue Pie.

(1) Line the sides of the pie-dish with the pastry.

(2) Put the sugar and water on to heat, pour in the blended cornflour and cook five minutes.

(3) Add the grated rind of one lemon and the juice of three lemons.

(4) Cool a little, then add the beaten yolks. Mix well.

(5) Beat the whites stiff, then fold them very carefully into the mixture.

(6) Put into the pie-dish. Make a lattice of pastry strips over the top. Bake 20 to 25 minutes in a moderate oven.

Ingredients.—½ lb. flaky pastry; ¾ pint boiling water; 3 lemons; 2 eggs; 2 tablespoons cornflour; ¾ cup castor sugar.

Orange Pie.

(1) Beat the yolks with the sugar, add 1 tablespoon butter, then the juice of the oranges, and lastly the milk.

(2) Bake in a pie-dish.

(3) When cooked, set to cool, then pour over it the whites stiffly frothed and sweetened, and place in the oven to brown.

Ingredients.—Pulp and juice of two oranges and a little of the grated peel; 3 eggs; 1 cup sugar; 1 cup milk.

Orange Cake.

(1) Beat butter and sugar to a cream. Then add eggs one at a time and juice and rind of oranges.

(2) Lastly the dry ingredients and bake in a moderate oven 40 minutes.

Ingredients.—1 cup sugar; 1½ cups flour; ½ cup butter; 3 eggs; 1½ teaspoons baking powder; juice of two naval oranges and rind of one.

Mandarin Jam.

(1) Cut fruit finely, peel lemons and cut finely.

(2) Boil till tender with the 5 pints of water.

(3) Stand aside till quite cold, add sugar and boil till jellies, about 1½ hours.

Ingredients.—20 thorny mandarins; 5 lb. sugar; 5 pints water; 2 lemons.

Mixed Citrus Marmalade.

(1) Cut up the fruit overnight and soak it in all the water.

(2) Boil next morning until tender. Then add a pint of boiling water and lastly 10 lb. sugar.

This makes a rich jellied marmalade which is simply delicious.

Ingredients.—4 mandarins; 3 grapefruit; 2 naval oranges; 2 lemons; 10 pints water; 10 lb. sugar.

Lemon Jam.

(1) Cut lemon finely and stand over night with the cups of water.

(2) Boil till tender, then add sugar and boil fast till jellies.

Ingredients.—1 medium-sized lemon; 1 cup sugar; 2 cups water.

KITCHEN GARDEN.

Cabbage, cauliflower, and lettuce may be planted out as they become large enough. Plant asparagus and rhubarb in well-prepared beds in rows. In planting rhubarb it will probably be found more profitable to buy the crowns than to grow them from seed, and the same remark applies to asparagus.

Sow cabbage, red cabbage, peas, lettuce, broad beans, carrots, radish, turnip, beet, leeks, and herbs of various kinds, such as sage, thyme, mint, &c. Eschalots, if ready, may be transplanted; and in cool districts horse radish can be set out.

The earlier sowings of all root crops should now be ready to thin out, if this has not been already attended to.

Keep down the weeds among the growing crops by a free use of the hoe and cultivator.

The weather is generally dry at this time of the year, so the more thorough the cultivation the better for the crops.

Tomatoes intended to be planted out when the weather gets warmer may be sown towards the end of the month in a frame where the young plants will be protected from frost.

A REMINDER TO ONION GROWERS.

Onion seed growers should, by this, have gone through their selected onions with the object of picking out the best keepers for the production of seed. The bulk of these onions should have been selected, previous to storing, for early maturity and variety characteristics. At the final selection bulbs that are soft or prematurely shooting, or those showing any indication of being bad keepers, or that are diseased, should be discarded.

The bulbs should be planted in rows at least 3 feet apart and spaced 2 feet apart in the rows. A handy position well protected from the boisterous winter winds should be selected for the growing of onion seed.

THE FARM VEGETABLE GARDEN.

The question of drainage should be considered in relation to all classes of soil, but especially in relation to those that are at all heavy. Neglect to make the necessary provision on such soils explains many failures to get good results from them during the winter months. Now is the time to think of the question of treatment.

Briefly, the objects of drainage are (1) to enable as much water as possible to percolate through the soil, and (2) to prevent the lodgment and stagnation of water on the soil surface by enabling excess quantities of water to be carried away with ease. It is especially necessary, of course, to drain clay soils. If water is allowed to remain on these for long they tend to "puddle," but if the water is drained away the soil does not become so compacted, retaining, instead, a more friable (crumbly) and porous condition.

Drainage may be of two kinds—surface or underground; the latter is the more effective, but it entails more labour and expense. A simple surface drainage scheme consists of shallow trenches running between plot and pathway, and connected up to an outlet at a suitable point. A modified form of surface drainage is expressed in a system of raised beds. Where some form of drainage is necessary, and the installation of the underground system is impossible, either of these methods is to be commended.

Underground drainage necessitates a considerable amount of trench digging. On what plan it is advisable to set out the drains will depend upon the size and contour of the area. In some cases a herring-bone design may be applicable, the main trench forming the backbone, so to speak, and running through the lowest portion of the land and the smaller contributory trenches spreading upwards from this. In other cases it may only be necessary to feed the main trench from one side, while in others again main trenches may best be laid at the edges of the area and fed from the centre. These trenches may then be partially filled with broken stones, and the surface of the filling protected with a layer of tin or brushwood, so that the earth with which it is subsequently overlaid may not drop through and destroy the porous character of the filling.

A drain provided with this rubble filling is usually the most convenient to make, and is quite effective; but a roughly-built conduit or channel may take the place of the broken stones, if desired. This may be made of flat stones or bricks, or (failing either of these) of boards. Only the sides and top need be formed of these materials, the trench floor serving for the bottom. The stones or bricks, or whatever is used, should only be loosely laid together, so that water may fall into the trench through them and be carried off. In country gardens, where saplings are easily available, these may be used effectively in the bottom of the trench (say a foot deep), covered by a 6-inch layer of brushwood.

The depth at which the drain should lie will depend upon the class of soil, but, needless to say, it should be sufficiently deep to allow of cultivation above it. If there is difficulty in arranging this the scheme should be so adjusted that the drain runs underneath the garden pathways, and not under the beds proper; 2 ft. 6 in. to 3 ft. is usually a satisfactory depth at which to lay a drain in the ordinary household plot.

There is little necessity for drainage on sandy soils, but gardeners working on land of a heavier character should set to work now to repair any deficiency in this direction. If the contour of the plot is regular it is not necessary to do the work all at once. As a section of the plot becomes vacant opportunity may be taken to carry out drainage work on it prior to preparing it for another planting. Then, when each section of the garden has been dealt with, the scheme can be connected up.—A. and P. Notes, N.S.W. Department of Agriculture.

Farm Notes for June.

FIELD.—Winter has set in, and frosts will already have been experienced in some of the more exposed districts of the Maranoa and Darling Downs. Hence insect pests will to a great extent cease from troubling, and weeds will also be no serious drawback to cultivation. Wheat sowing should now be in full swing, and in connection with this important operation should be emphasised the necessity of at all times treating seed wheat by means of fungicides prior to sowing. Full directions for "pickling" wheat by copper carbonate treatment are available on application

to the Department of Agriculture, Brisbane. Land intended for the production of early summer crops may now receive its preliminary preparation, and every opportunity taken advantage of to conserve moisture in the form of rainfall where experienced; more particularly so where it is intended to plant potatoes or early maize. Where frosts are not to be feared the planting of potatos may take place in mid-July; but August is the recognised month for this operation. Arrowroot will be nearly ready for digging, but we would not advise taking up the bulbs until the frosts of July have occurred. Take up sweet potatoes, yams, and ginger. Should there be a heavy crop, and consequently a glut in the market, sweet potatoes may be kept by storing them under cover and in a cool place in dry sand, taking care that they are thoroughly ripe before digging. The ripeness may be known by the milky juice of a broken tuber remaining white when dry. Should the juice turn dark, the potato is unripe, and will rot or dry up and shrivel in the sand pit. Before pitting, spread the tubers out in a dry barn, or in the open if the weather be fine. In pitting them or storing them in hills, lay them on a thick layer of sand; then pour dry sand over them till all the crevices are filled and a layer of sand is formed above them; then put down another layer of tubers, and repeat the process until the hill is of the requisite size, and finally cover with either straw or fresh hay. The sand excludes the air, and the potatoes will keep right through the winter. In tropical Queensland the bulk of the coffee crop should be off by the end of July. Yams may be unearthed. Sugar-cane cutting may be commenced. Keep the cultivator moving amongst the pineapples. Gather all ripe bananas.

Cotton crops are now fast approaching the final stage of harvesting. Growers are advised that all bales and bags should be legibly branded with the owners' initials. In this matter the consignor is usually most careless, causing much delay and trouble in identifying parcels, which are frequently received minus address labels.

Orchard Notes for June.

THE COASTAL DISTRICTS.

THE remarks that have appeared in these notes for the past two months apply in a great measure to June as well, as the advice that has been given regarding the handling, grading, packing, and marketing of the citrus crop still holds good. As the weather gets cooler the losses due to the ravages of fruit flies decrease, as these insects cannot stand cold weather, and consequently there is only an odd one about. The absence of flies does not, however, permit of any relaxation in the care that must be taken with the fruit, even though there may be many less injured fruit, owing to the absence of fruit-fly puncture, as there is always a percentage of damaged fruit which is liable to speck, which must be picked out from all consignments before they are sent to the Southern States if a satisfactory return is to be expected. If the weather is dry, citrus orchards must be kept in a good state of tilth, otherwise the trees may get a setback. Old worn-out trees can be dug out and burnt; be sure, however, to see that they *are* worn out, as many an old and apparently useless tree can be brought round and made to bear good crops, provided the trunk and main roots are still sound, even though the top of the tree is more or less dead. The whole of the top of the tree should be cut off and only the trunk and such sound main limbs left as are required to make a new head. The earth should be taken away from around the collar of the tree, and the main roots exposed, any dead roots being cut away and removed. The whole of the tree above ground and the main roots should then be dressed with a strong lime sulphur wash or Bordeaux paste. The main roots should be exposed for some time, not opened up and filled in at once. Young orchards can be set out now, provided the ground is in good order. Don't make the mistake of planting the trees in improperly prepared land—it is far better to wait till the land is ready, and you can rest assured it will pay to do so in the long run.

When planting, see that the centre of the hole is slightly higher than the sides, so that the roots, when spread out, will have a downward, not an upward, tendency; set the tree at as nearly as possible the same depth as it was when growing in the nursery, cut off all broken or bruised roots, and spread those that remain evenly, and cover them with fine top soil. If the land is dry the tree should then be given a good watering, and when the water has soaked in the hole can be filled up with dry soil. This is far better than watering the tree after the soil has been placed round it and the hole filled up. Custard apples will be ripening more slowly as the nights get colder. If the weather becomes unduly cold, or if immature fruit is sent South, the fruit is apt to turn black and be of no value. This can easily be overcome by subjecting the fruit to artificial heat, as is done in the case of bananas,

during the cooler part of the year, when it will ripen up properly and develop its flavour. Grade custard apples carefully, and pack in cases holding a single layer of fruit only for the Southern markets.

Pineapples, when at all likely to be injured by frost, should be protected by a thin covering of bush hay or similar material. The plantation should be kept well worked and free from weeds, and slow-acting manure, such as bonedust or island phosphates, can be applied now. Lime can also be applied when necessary. The fruit takes longer to mature at this time of the year; consequently it can be allowed to remain on the plant till partly coloured before gathering for the Southern markets, or can be fully coloured for local use.

Banana plantations must be kept worked and free from weeds, especially if the weather is dry, as a severe check to the plants now means small fruit later on. Bananas should be allowed to become full before the fruit is cut, as they will carry all right at this time of the year; in fact there is more danger of their being injured by cold when passing through New England by train than there is of their ripening up too quickly.

Bear in mind the advice given with regard to the handling, grading, and packing of the fruit. It will pay you to do so. Land intended for planting with bananas or pineapples during the spring should be got ready now.

Strawberries require constant attention, and, unless there is a regular and abundant rainfall, they should be watered regularly. In fact, in normal seasons an adequate supply of water is essential, as the plants soon suffer from dry weather or strong, cold westerly winds. Where not already done, vineyards should be cleaned up ready for pruning—it is, however, too early to prune or to plant out new vineyards.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

ALL kinds of deciduous fruit trees are now ready for pruning, and this is the principal work of the month in the orchards of the Granite Belt area. Don't be frightened to thin out young trees properly, or to cut back hard—many good trees are ruined by insufficient or bad pruning during the first three years. If you do not know how to prune, do not touch your trees, but get practical advice and instructions from one or other of the Departmental officers stationed in the district. In old orchards do not have too much bearing wood; cut out severely, especially in the case of peaches, or you are likely to get a quantity of small unsaleable fruit. There are far too many useless and unprofitable fruit trees in the Granite Belt area, which are nothing more or less than breeding-grounds for pests, such as fruit-fly, and are a menace to the district. Now is the time to get rid of them. If such trees are old and worn-out, take them out and burn them, but if they are still vigorous, cut all the tops off and work them over with better varieties in the coming season—apples by grafting in spring and peaches and other stone fruits by budding on to young growth in summer. Planting can start now where the land is ready and the trees are to hand, as early-planted trees become well established before spring, and thus get a good start. Be very careful what you plant. Stick to varieties of proved merit, and few at that, and give so-called novelties and inferior sorts a wide berth. Take the advice of old growers, and do not waste time experimenting with sorts that have probably been tested in the district and turned down years ago. When land is intended for planting this season, see that it is well prepared and well sweetened before the trees are put in, as young trees seldom make a good start when planted in sour and badly prepared land.

Slowly acting manures—such as bonedust, meatworks manure, or island phosphates—can be applied now, as they are not liable to be washed out of the soil, and they will be available for the use of the trees when they start growth in spring. Lime can also be applied where required. Badly drained land should be attended to, as no fruit trees will thrive with stagnant water lying round their roots.

On the Downs and Tableland all kinds of fruit trees can be pruned now, and vines can be pruned also in any district where there is no danger from late frosts, and where this can be done the prunings should be gathered and burnt, and the vineyard ploughed up and well worked to reduce the soil to a good state of tilth, so that should rain come it will absorb all that falls and the moisture can be kept in the soilby cultivation subsequently.

Citrus fruits will be at their best in the Western districts. The trees should be watered if they show signs of distress; otherwise all that is necessary is to keep the surface of the land well worked. All main-crop lemons should be cut by this time, as, if allowed to remain longer on the tree, they only become overgrown and are more suitable for the manufacture of peel, whereas if cut and cased now they will keep in good order so that they can be used during the hot weather.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF MARCH, IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALL DURING MARCH, 1934, AND 1933, FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.		Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	Mar.	No. of Years' Records.	Mar., 1934.	Mar., 1933.		Mar.	No. of Years' Records.	Mar., 1934.	Mar., 1933.
North Coast.	In.		In.	In.	*Central Highlands.*	In.		In.	In.
Atherton	8·30	33	14·36	2·53	Clermont	3·05	63	0·03	0·10
Cairns	17·87	52	19·11	12·48	Gindie	2·62	34	..	0·30
Cardwell	15·62	62	8·87	2·87	Springsure	2·91	65	0	0·42
Cooktown	15·03	58	9·81	8·81					
Herberton	7·51	48	12·80	1·28					
Ingham	15·50	42	8·49	4·96					
Innisfail	25·87	53	32·38	10·05					
Mossman Mill ..	17·32	20	27·16	12·23	*Darling Downs.*				
Townsville	7·29	63	0·85	0·33					
					Dalby	2·67	64	0·01	0·05
Central Coast.					Emu Vale	2·34	38	0	0
					Hermitage	2·18	27	0	0
Ayr	6·49	47	0·22	0·13	Jimbour	2·52	46	0	0
Bowen	5·56	63	1·62	0·24	Miles	2·65	49	0·05	0·86
Charters Towers ..	3·74	52	0·59	0·02	Stanthorpe	2·62	61	1·03	0·85
Mackay	11·81	63	6·47	0·88	Toowoomba ..	3·72	62	0·23	0·27
Proserpine	11·76	31	10·33	6·04	Warwick	2·48	69	0	0
St. Lawrence ..	5·23	63	0·46	0·62					
South Coast.									
					Maranoa.				
Biggenden	3·77	35	0·95	0·28					
Bundaberg	5·04	51	1·85	0·84					
Brisbane	5·65	83	0·82	0·55	Roma	2·57	60	0·23	0·01
Caboolture	7·55	47	4·30	1·85					
Childers	4·43	39	1·35	0·21					
Crohamhurst	11·27	40	4·79	2·00					
Esk	4·72	47	0·78	0·04					
Gayndah	3·02	63	0·65	0					
Gympie	6·11	64	2·38	0·33	*State Farms, &c.*				
Kilkivan	3·85	55	0·41	0					
Maryborough ..	5·88	63	2·53	0·96	Bungeworgorai ..	1·55	19	0·40	0·75
Nambour	9·10	38	3·97	2·75	Gatton College ..	3·17	34	0·32	0·08
Nanango	3·38	52	0·54	0·04	Kairi	7·69	19	..	2·55
Rockhampton ..	4·41	63	0·23	0·11	Mackay Sugar Experiment Station	10·84	36	5·30	0·96
Woodford	7·80	47	3·40	1·50					

GEORGE G. BOND, Divisional Meteorologist.

CLIMATOLOGICAL TABLE—MARCH, 1934.

COMPILED FROM TELEGRAPHIC REPORTS.

Districts and Stations.	Atmospheric Pressure. Mean at 9 a.m.	Shade Temperature.						Rainfall.	
		Means.		Extremes.				Total.	Wet Days.
		Max.	Min.	Max.	Date.	Min.	Date.		
Coastal.	In.	Deg.		Deg.		Deg.		Points.	
Cooktown	29·81	84	74	86	1, 3, 11, 14, 23 31	71	16, 26	981	23
Herberton	..	75	62	79	25, 26	56	20	1,280	22
Rockhampton	29·98	86	68	91	20	64	20	23	4
Brisbane	30·08	81	65	86	20	60	29	82	10
Darling Downs.									
Dalby	30·05	86	59	93	7	50	29	1	1
Stanthorpe	..	78	54	88	1, 24	45	6, 19	103	7
Toowoomba	..	78	59	86	24	49	19	23	2
Mid-interior.									
Georgetown	29·85	90	68	94	24, 25	60	21	24	3
Longreach	29·94	95	68	100	1	60	29	12	2
Mitchell	30·02	88	61	95	7, 22	52	21, 29	35	1
Western.									
Burketown	29·83	91	74	99	12	71	29	96	5
Boulia	29·87	96	73	100	2,12,19-22, 25	69	8, 29	Nil.	..
Thargomindah	29·95	95	73	105	1	64	26	Nil.	..

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON, F.R.A.S., AND A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

	May, 1934.		June, 1934.		MOONRISE. May, 1934.	June, 1934.
	Rises.	Sets.	Rises.	Sets.	Rises.	Rises.
					p.m.	p.m.
1	6·19	5·19	6·37	5·2	6·27	8·33
2	6·20	5·18	6·37	5·2	7·27	9·42
3	6·20	5·18	6·38	5·2	8·31	10·47
4	6·21	5·17	6·38	5·2	9·37	11·49
5	6·21	5·17	6·39	5·2	10·44	a.m.
6	6·22	5·16	6·39	5·2	11·48	12·51
7	6·22	5·16	6·39	5·2	a.m.	1·49
8	6·23	5·15	6·40	5·2	12·54	2·47
9	6·23	5·14	6·40	5·3	1·57	3·48
10	6·24	5·13	6·40	5·3	2·56	4·47
11	6·24	5·13	6·40	5·3	3·55	5·43
12	6·25	5·12	6·40	5·3	4·53	6·38
13	6·25	5·11	6·41	5·3	5 55	7·30
14	6·26	5·11	6·41	5·3	6·55	8·18
15	6·26	5·10	6·41	5·3	7·51	9·1
16	6·27	5·9	6·41	5·3	8·45	9·37
17	6·28	5·9	6·42	5·4	9·36	10·10
18	6·28	5·8	6·42	5·4	10·23	10·39
19	6·29	5·8	6·42	5·4	11·3	11·8
20	6·29	5·8	6·42	5·4	11·37	11·37
					p.m.	p.m.
21	6·30	5·7	6·43	5·4	12·9	12·8
22	6·30	5·7	6·43	5·4	12·39	12·40
23	6·31	5·7	6·43	5·4	1·7	1·16
24	6·32	5·6	6·44	5·4	1·37	1·58
25	6·32	5·6	6·44	5·5	2·10	2·51
26	6·33	5·5	6·44	5·5	2·44	3·54
27	6·34	5·5	6·44	5·5	3·24	5·2
28	6·34	5·4	6·44	5·5	4·12	6·12
29	6·35	5·4	6.44	5.6	5·10	7·24
30	6·35	5·3	6·44	5·6	6·14	8·31
31	6·36	5·2	..	..	7·23	..

Phases of the Moon, Occultations, &c.

6 May.	☽	Last Quarter	4 41 p.m.
13 ,,	●	New Moon	10 30 p.m.
22 ,,	☾	First Quarter	1 20 a.m.
29 ,,	○	Full Moon	7 41 a.m.

Apogee, 19th May, at 5.54 a.m.
Perigee, 31st May, at 5.12 a.m.

The Moon will occult Antares, the principal star of Scorpio, about an hour after midnight of the 1st of May.

The nearest approach of Mercury to Mars, to within about half a degree on the 8th, will be prevented from being a popular spectacle by the closeness of the Sun, which passed Mars from west to east on the 14th of April.

The nearness of the Moon to Venus at 10 a.m. on the 10th will be interesting to notice, with or without binoculars, although in broad daylight. They will be high up towards the N.N.W., only 4½ degrees east of the 24th meridian, which may be said to run along the eastern side of the Great Square of Pegasus. The distance of Venus from the Moon on its southern or upper edge will be 6 degrees, the length of the Southern Cross.

On the 13th Mercury will be in superior conjunction with the Sun, and so remarkably in a line with it as to be only one minute of arc from the Sun's centre when directly behind it.

On the same day the Moon will be new at 10.13 p.m. It will reach Mars at midday and Mercury 14 hours later, but all three will be entirely lost in the glare of the Sun.

Neptune, having reached Right Ascension 10.46 on the 21st, will become stationary for about seven days, after which it will resume its eastern motion till the end of the year. From our point of view Neptune reached Leo on 24th July, 1922, and has remained with that constellation as its background up to the present time. About another years seems to be required before Neptune will reach Virgo.

The Moon will give a good indication of Neptune, which will be 4 degrees north of it, on the 22nd at 11 p.m., when both will be getting down to the western horizon.

The conjunction of Jupiter and the Moon will take place at 5 p.m. on the 25th, when Jupiter will be 7 degrees to the northward. An hour later both may be distinctly visible in the north-east, but the distance between them will then be 7½ degrees.

Antares will be again occulted on the 29th before midday, when the star and Moon will be 4½ hours below the western horizon.

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4 June	☽	Last Quarter	10 53 p.m.
12 ,,	●	New Moon	12 11 p.m.
20 ,,	☾	First Quarter	4 37 p.m.
27 ,,	○	Full Moon	3 8 p.m.

Apogee, 15th June, at 8.18 p.m.
Perigee, 28th June, at 10.54 a.m.

For places west of Warwick and nearly in the same latitude, 28 degrees 12 minutes S. add 4 minutes for each degree of longitude. For example, at Inglewood, add 4 minutes to the times given above for Warwick; at Goondiwindi, add 8 minutes; at St. George, 14 minutes; at Cunnamulla, 25 minutes; at Thargomindah, 33 minutes; and at Oontoo, 43 minutes.

The moonlight nights for each month can best be ascertained by noticing the dates when the moon will be in the first quarter and when full. In the latter case the moon will rise somewhat about the time the sun sets, and the moonlight then extends all through the night; when at the first quarter the moon rises somewhat about six hours before the sun sets, and it is moonlight only till about midnight. After full moon it will be later each evening before it rises, and when in the last quarter it will not generally rise till after midnight.

It must be remembered that the times referred to are only roughly approximate, as the relative positions of the sun and moon vary considerably.

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